PAPER PRESENTATION AT THE LANDMARK UNIVERSITY QUARTERLY SEMINAR

TOPIC: SCIENCE AND TECHNOLOGY EDUCATION IN AGRICULTURAL REVOLUTION

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SCIENCE AND TECHNOLOGY EDUCATION IN AGRICULTURAL REVOLUTION

1.0 GREETINGS AND GRATITUDE

First, I greet and welcome you all to this scholarly exercise. I pray you will not regret your coming in Jesus name. When the Vice Chancellor, Professor Matthew Ola-Rotimi Ajayi, announced the Scholarly lecture series which would involve Professors and Senior Lecturers, there was a sign of discomfort in me. The discomfort was aggravated when he added that the series of lectures would be in two folds, one for Professors and the other for emerging scholars, the Senior Lecturers.

I felt uncomfortable not because I do not want to be involved but because I thought within me that I have delivered my inaugural lecture some years ago in one of my former Universities where I worked and earned my Professorship. Why should I deliver another one? After all, we were made to understand that inaugural lectures are delivered only once in ones life time.

The rigour involved in preparing for an inaugural lecture is enough to make one feel uncomfortable if you have to repeat such a lecture.

On second thought later, I found the new move as another chance to blow one's trumpet particularly on the activity one is known for. What I discovered is that the rigorous preparation for the inaugural lecture is a booster to other related future activities. The information you need are already in stock. You only need to draw out of it, delete or add from it as the new topic demands. This way you have rejuvenated yourself.

Looking at the exercise of today from my analysis, I would like to express my gratitude to the former Vice Chancellor and other people behind the decision to start the lecture series for making me alive again in my chosen field, Science Education with Physics as a major science subject.

2.0. INTRODUCTION

I have passed through a long road to be where I am today both in terms of education and working life. Educationally, I have passed from General education at Primary school level through Secondary school and intermediate education in science; specialist in Physics, Electronics and Telecommunication to Science and Technology Education.

In the working life, I taught Physics and Mathematics at secondary school and intermediate level, and Physics, Science and Electronics at tertiary level.

I have been involved in Teachers' preparation at tertiary education level (College of Education and University) and now back to Physics Teaching at University level.

Career-wise, I have moved from a secondary school Physics and Mathematics teacher through Lecturer II, Lecturer I, Senior Lecturer, Principal Lecturer, and Associate Professor to a Professor.

It looks as if the road has not been easy, but I have enjoyed it all.

Thanks to my benefactors, benefactresses and mentors. There is no iota of regret at all for being a teacher and a teacher trainer all the way. Glory be to God for this. As I said in my Inaugural Lecture in 1998, the time has come for me to blow my own trumpet as other scholars have done. It is like the Day of Judgment has come when I have to account for my stewardship as a practicing Science Educator of the highest degree. I have been involved in learning, teaching, researching, disseminating information and conducting/participating in workshops, seminars, symposia and dialogues in Science Education for over fifty years now. As a matter of fact, I know no other trade than all these. My exposure to Technology Education started with higher education in electronics and Telecommunication about forty six years ago. I have a lot to say on science and Technology Education but not in this lecture as my job today is to relate Science and Technology Education to Agriculture, the main focus of Landmark University.

The question now is from where do I start? It is not easy to go straight to the topic just like that as many concepts are involved. These concepts need clarification in order to understand and appreciate what would follow. I have therefore decided to open the Lecture with the meaning of Science Education through the meaning of Science and Education.

This will be followed by the meaning of Technology Education through the meaning of Technology and Education. You will agree with me that I should comment briefly on Agricultural Revolution through the meaning of Agriculture and Revolution. After all these clarifications, I can then

proceed to consideration of Science Education and Agricultural Revolution followed by Technology Education and Agricultural Revolution. The last but one section of the lecture will be on the way-forward for success in Agricultural Revolution. The lecture will end with an acknowledgement as a rounding up.

3.0. DEFINITONS AND EXPLANATION OF KEY WORDS

3.1. Education

> ***Education can generally be seen as the identification, the development and the use of human potentialities or powers as a means of preparing an individual for effective living within and outside the society***
> **(Cronbach 1964 and Olarinoye 1984)**

This definition includes the view of Education from the socialization point of view. Human beings are the same in basic nature all over the world. What brings about the noticeable differences are the environments (both physical and social) and heredity. The measures of these potentialities or powers are the various human talents which are there right from birth. Through education the talents can first be identified and then developed for use.

Calvin Taylor (1964), a leading American developmental psychologist has identified about 120 talents. There is nobody without more than two talents. Intellectual ability involves the realization and uses of these Talents. Academic talent is part of Intellectual ability which is measured through achievement tests. Academic talents include the ability to read, write research and disseminate information. Included in this definition of Education is the development of appropriate skills and attitudes for effective living in any society. Looking at education from socialization point of view, there cannot be a single definition all over the world, even within a country because of cultural differences.

3.2. Science

Science is a dynamic human activity which calls for doing, making, observing, explaining, deducing and arriving at a tentative understanding of a phenomenon, be it natural or created by human beings. An insight gained in the understanding of a phenomenon leads to further aggressive search for more information about the phenomenon. Man is a wonderful and curious animal and he has the capacity to delve into any area of knowledge. The outcome of human endeavor becomes a springboard for further research activities for controlling events or phenomenon and for harnessing the outcomes for the service of humanity. Science as a dynamic and organic discipline has evolved two schools of thought. The first school of thought posits that theory is the canon for measuring research. The second school holds that the detailed analysis of the history of science is science per se. The proponents of the second school see theory as a mere tool in science activities. Kuhn (1962),a leading proponent of the 'new' philosophy of science posits **"..., no theory solves the puzzles with which it is not confronted at a given time; nor are the solutions achieved often prefect."** The new philosophy of science redefined science as **"……..tentative, dubitable, anti-authoritarian, contingent and visionary rather than rhetoric of conclusions"**. Science is doing under great patience and forbearance. Robert Fisher (1975) defined science as **"the body of knowledge obtained by methods based upon observation."**

This last definition carries several implications. Let me list here four most significant ones:

1. The practice of science is a human activity. Human beings do the observing, employ the methods and gain the body of knowledge.
2. There is an inherent limitation of science. Anything that is outside of or beyond the senses with which people can observe is, in principle, outside of or beyond the bounds of science.
3. There is an authority in science. The practical authority is observation and the underlying authority is that which is observed.
4. There is a building upon the authority. The methods are based upon but not limited to observation

There are many other definitions of science. In fact there are as many definitions as the number of scientists. Fisher's definition is preferred because of its simplicity and operational value.

3.3 Science Education

Science Education is a hybrid academic and professional field of human endeavor. It consists of science and education but it is more than either in theory and practice. It is an applied field in education. Its practitioner is a molder and enabler, a facilitator, a counselor, a nourisher, a motivator, a builder or developer and a model as far as teaching and learning science is concerned.

Science Education is seen as a field of study in the formal education system. I have once synthesized the meaning of Science Education from an analysis of the meaning of Science and Education in a paper titled **"what is Science Education? (Olarinoye, 1984)".** In this paper, I looked at science education as: '***The identification, development and use of human talents or potentialities through the acquisition of scientific concepts, principles, inquiry skills, conceptual schemes and involvement in scientific enterprise as a whole'.***

The inquiry skills include those to engage in the process of science, for example, observation, hypotheses, testing, data collection and ordering of knowledge. It includes; evaluation in science and its teaching.

The scientific enterprises are the contextual situation in which science exists. It encompasses everything involved in science; the nature of science, technology and society, limitation of science, role of scientists and the like.

An American Professor has defined Science Education as the marriage of science and child. Science Education is child-centered. The child is the husband (independent variable) and science the wife (dependent variable) so to speak. Through Science Education, the child manipulates scientific knowledge in such a dose as to identify, develop and make use of his talents or potentialities for the benefit of himself and the society in general.

The goal of Science Education is to develop scientifically literate individuals. Scientific literacy includes knowledge of the scientific information, laws, principles, conceptual schemes and inquiry skills. Possession of such knowledge, is essential to scientific literacy, but in itself, it is not sufficient.

Understanding should follow wherever appropriate. The scientifically literate individual possesses the ability to use the fundamental aspect of science in everyday problem-solving and in personal and public decision making. Finally, scientific literacy includes an appreciation of scientific enterprise and the various fundamental aspects of science (See Appendix A). The essence of science is its usefulness as a powerful tool in the discovery of knowledge by means of observation, experimentation and problem-solving. Learning about the work of science or actually engaging in it helps thoughtful individuals to acquire favourable attitudes and formulate reasoned value-judgment about science. The objective of Science Education and the elements of scientific literacy are clearly that, Science Education deals with the learning and teaching of science. As we have curricula for learning science, so we have curricula for teaching science. Our attention in this paper, then, as far as Science Education is concerned, is on both the learning and teaching of science.

Like and as Physics Education, Science Education includes research in problems of teaching and learning and dissemination of the outcomes. As a matter of fact, this is the main work of a science educator at higher level. He is searching for the truth behind the poor achievement in science by students, particularly those in schools. In effect, he is concerned with ineffective or poor learning of science.

3.4. Technology

Technology, according to Robert Fisher (1975), is **"the totality of the means employed by people to provide material objects for human sustenance and comfort."** This is also a simple operational or working definition of technology. It was predicted by Berkner (1964) that "**by year 2000, technology would have become almost completely science-based, deriving its strength for the constant and basic generation of science.**" The prediction appears to have merit. As at now, almost fourteen years after the year 2000, technology has become a household word in theory and applications. All over the world, technology is always associated with science. Time and space will not permit me to write a lot on Science and Technology and their relationships. Sufficient to write that technology today relies very heavily upon basic scientific knowledge in addition to prior technology. There is also a strong influence in the reverse direction. Modern science relies to a considerable extent upon existing technology as well as upon prior scientific

knowledge. For example, the technological development of commercial electron microscopes was based very heavily on science. In fact, long before the first experimental model was constructed, applications for basic patents on such an instrument were made entirely on the basis of scientific knowledge that the instrument was theoretically possible. Now that electron microscopes are readily available commercially, this technological accomplishment is very important and useful in a wide variety of further researches in pure science. Science and Technology reinforce each other by way of complex, two-way interactions. Technology is dependent upon science for knowledge of the properties of energy, for predicting the behavior of natural forces and for opening up new fields of technology for its tools and instruments, for the preparation of materials, for the storage and dissemination of information and for simulation of further research.

In terms of motives of Science and Technology, Price (1968) suggested that

> ***The scientist wants to write ……. And the technologist wants to read…… .. it would not be a bad situation if the stuff that the technologist wanted to read was exactly that which the scientists were writing***

Unfortunately, the above suggestion may not exactly apply as the final product of technology itself cannot be obtained exactly at the first attempt. It is therefore finally obtained by trial and error.

3.5 Technology Education

Technology education is education that facilitates the production of material objects for the human sustenance and comfort. It involves the learning and teaching of the knowledge and skills involved in these productions. A technology educator may not necessarily be solely involved in producing material objects for human sustenance and comfort. His main job as an educator is to impart knowledge and skills involved in this production through teaching, disseminating information and related community services.

It is indeed the importance attached to technology that makes technology education necessary. In industries, the area of computer, automated machine, man-made satellites, tranquilizers; plastics and many other chemical and petro-chemical products are technological achievements.

Technology education Programme which exists in universities are mainly for the production of teacher of technological subjects which include applied electricity, electronics, metal work, wood work, building and auto-mechanic.

3.6 Agriculture

According to the Oxford Advanced learner's Dictionary (7th Edition)edited by Sally Weheimer, et al, Agriculture is the science or practice of farming. A farm is defined by the same dictionary as an area of land, and the buildings on it used for growing crops and /or keeping animals. To farm therefore is to use land for growing crops and /or keeping animals.

Farming is not restricted to using land to grow crops and /or keeping animals. It also refers to arranging for somebody or people to be cared for by other people or sending out work for other people to do.

However, in this paper, farming is restricted to using land for growing crops and/or keeping animals. Animals here refer to fish, cattle, goats, snails, and other domesticated beings apart from human beings. After man was driven away from the Garden of Eden by God as a result of the sin he committed through disobedience, he became a wanderer and attached himself to a moving herd of sheep, goats and dogs. Later, he started domesticating those animals and continued to live as a forager and hunter. Thus, Agriculture started with keeping and moving with animals. As a result of an act of will and nature, man started to settle to become a villager.

In the burst of new vegetation at the end of the ice age, hybrid wheat appeared in the Middle East. It happened in many places; a typical one is the ancient Oasis of Jericho. Jericho is older than Agriculture. The first people who came here and settled during spring in this otherwise desolate ground were people who harvested wheat but did not yet know how to plant it. They made sickles out of flint for harvesting the natural hybrid wheat. This was the period of pre-agricultural civilization. Agricultural civilization started with the occurrence of two forms of wheat with the extinction of the natural hybrid wheat. This was on the Jericho tel. Thus, Civilization in its fullest meaning started with the planting of what later became bread wheat seeds.

3.7 Revolution

According to the same Oxford Advanced Learners Dictionary earlier mentioned, revolution is defined as "**A great change in condition, ways of working, beliefs, etc. that affects large number of people".** There are other definitions but I have decided to adopt this for the lecture. Whatever way of looking at the term "Revolution", it is brought about by the people involved for a change of purpose, a change from the old way of doing things. In most cases, Revolution brings progress and prosperity if well handled. The industrial

revolution is an example. It consisted of tremendous technological innovations that resulted in many changes in the types of goods produced in industries and the ways in which they were produced.

3.8 Agricultural Revolution

Agricultural Revolution is the revolution brought about in Agriculture. From the definitions of Agriculture and Revolution, Agricultural Revolution refers to a great change in conditions and ways of farming that affects large number of people. This includes changes in everything under farming. Activities such as enriching growth, harvesting, processing, and packaging in the case of plants and feeding, slaughtering, processing and packaging in the case of animals are included also. The technological innovations brought about by the Industrial Revolution in Britain helped in Agricultural Revolution. For example, the introduction of tractor (a product of industrial revolution) in 1920s brought about a rapid development in farm mechanization. Many attachments were quickly developed by means of which the tractor took over the main role in performing many of the operations in farming; such as planting, cultivating, harvesting, threshing, and even sowing. With the modern scientific based technology on the farm, one person can produce far more now than was possible some time ago.

4. Science Education and Agricultural Revolution

Science Education can be viewed from two perspectives, namely: As Education in science and as science in Education. Both can be seen as ends in themselves. Education in science applies to studying Science and its applications formally in schools, Colleges, Universities and research institutions. Beneficiaries of this are holders of various degrees in the Sciences and their applications. They are specialists in their various fields and to them, Education in science is an end in itself, though you find many of them in Educational Institutions as teachers, lecturers etc.

Science in Education is a hybrid of Science and Education as fields of study. It is an applied Science in Education. Beneficiaries of this are professional Educators in Science and its applications. You do not find them anywhere else apart from Educational or related Institutions. To them, education is an end in itself. They combine Science with Education in their training. They can teach Science too but they are more than Scientists. They are Science Educators as they can do more than teaching. Of course, both groups in Science Education

are researchers. Whereas, the specialists in science and its applications carry out research activities in their fields of specialization, the Science Educators carry out research activities in Science Education areas such as teaching methodology, scientific attitudes, Processes and Skills. Both have roles to play in Agricultural Revolution. Agricultural Revolution brings about technological innovations in Agriculture.

As said earlier, up to the period after the industrial revolution, many people lived on farms. The effects of industrial revolution later brought about Agricultural Revolution which culminated in technological innovations. There were reasons or incentives for this. First was the strong desire to eliminate or at least to minimize the hard manual labor involved in farming. Another factor was the realization that farmland that had been under cultivation for a number of years tended to lose its productivity. This was seldom a cause of much worry since there was an increase in population. Something has to be done to restore the land for further productivity. In the United States, another incentive for innovation and change or revolution in Agriculture in the mid-nineteenth century was the rather limited number of different crops being grown up to that time. Numerous other crops were under cultivation and were been harvested in other parts of the world, and it was recognized that some of these crops might be appropriate for introduction into the United States.

Faced with these incentives for Agricultural innovations, how was Agriculture to go about accomplishing them? The answer can be provided by Science and Technology Education. The role of Technology here would be taken up later but that of science would be taken up now. In the United States, the federal Government took over and played a leading role in fostering related scientific study and Research. Colleges of Agriculture were introduced throughout the Country for this. Scientists were sent to Europe and Asia to study new varieties of plants with a view towards cultivating appropriate ones in the United States.

With these acts, Scientific and Technological developments in Agriculture with Science as the basis have resulted in high level of economic prosperity for the farmers. This is confirmed by the following statements attributed to one Secretary of Agriculture in the United States of America:

> ***The Man with the hoe has become the Man with the harvester, and he is the depositor and shareholder of the bank. (One US secretary of State early 1900s)***

In the United States, as of now, with modern Scientific and Technology through relevant Education in schools, Colleges and Universities, one person can produce far more now than was possible some time ago. Data published by the U.S. Federal Government indicated that from 1950 to 1969 the real product per man –hour in Agriculture increased by a factor of about 2.7, whereas the corresponding increase in non-farm productivity was by a factor of 1.5, consequently, the Cultural and Sociological impacts have been considerable.

5. Technology Education and Agricultural Revolution

As said with science Education, the two classification of specialists hold. As we have Technologists who passed through education in formal Schools, Colleges and Universities, there are also Technology educators whose main jobs are in education or educational related institutions. Both have roles to play in Agricultural Revolution.

As said earlier, Technology is production - oriented. The technology we are talking about here are those that are science-based. They produce technological innovations that could take care of the incentives identified earlier for improvement in Agriculture. In summary, these incentives are:

i) The strong desire to eliminate or at least to minimize the hard manual labor involved in farming;
ii) The realization that farm-lands that have been under cultivation for a number of years tended to lose their productivity – this has to be restored;
iii) The rather limited number of different crops being grown – more of those are required;
iv) The need for increased food production;
v) The need to control pests of all kinds;
vi) The need for high quality foodstuffs including animal production; and
vii) The need for better storage of farm products.

The question here is “what is the role of Technology Education in taking care of these incentives for technological innovations in Agriculture”?

The use of the tractor alone takes care of many of the incentives. The use of a tractor will minimize the hard manual labor involved in farming and help in

producing more food. Technology Education Curriculum could be revisited in colleges and Universities.

For example in United State of America, the Morill land – Grant Act of 1862 provided for the endowment, support and maintenance of Colleges to be established in each of the States. The objective of these Colleges was to teach such branches of learning as Agriculture and the Mechanical arts. A subsequent act of congress called upon the States to establish Agricultural experiment stations within the Agricultural Colleges. By 1880, 28 land – grant Colleges had been established in 28 states.

Agricultural Revolution continued in the United States through the introduction of more technological innovations. Although all the incentives for revolution in Agriculture have been taken care of by the Federal Government, efforts continue to be made for improvement through Science and Technology Education

6.0 Personal Contributions to Science Education in Nigeria

6.1. Preamble

6.11 Introduction

So far, I have spelt out the meanings of the various key concepts, and related science and technology education to Agricultural Revolution. **The question now is what are my contributions to Science and Technology Education?** I consider it necessary to answer this question before I end up with the way forward to achieving Agricultural Revolution through science and Technology education. What are my contributions then? Mr. Chairman, Ladies and Gentlemen, I have come through a long route to education as a professional and academic field. if education, as believed, begins from birth and terminates at death (though it is believed that there is life after death), I would say that as far as my conscious self is concerned, my education is so far from childhood (beginning from Primary school) to the present stage. This is education in its total perspective. As a professional and academic field of human endeavour, I have come to be an educationist through History, geography, English Language, Physics, Chemistry, Biology, and Mathematics right from secondary school. At higher secondary school, these were narrowed down to physics, chemistry and mathematics. This trend continued up to the end of the second

year of my undergraduate studies. This narrowed down to physics as a major subject in my final year in the University for my Undergraduate Studies.

It will therefore be necessary to comment briefly on the way I see these subjects as a professional Educator. I use mathematics quite alright as an educator and educated in it but I do not see myself as a mathematics educator. I would therefore concentrate on physics education, Science Education, Technology Education and Education.

A lot has been said about science education and education. Discussions on these will therefore be omitted here. After a brief discussion on each of the other areas. I would concentrate on my personal contributions to Science Education in Nigeria.

Physics Education

Let us look at physics first of all. A century ago, there was no clear cut division between the physical sciences as we know them now namely: Physics, Chemistry, Astronomy, Geology, Meteorology etc. Instead, all that was known in these fields was included in the single term "**Natural Philosophy**". Before long, differentiation and splitting off began. Astronomy and Chemistry developed methods and procedures of their own and at the same time; the invention of new means of motive power such as steam engine and the electric motor gave rise to the profession of engineering. Of the original content of natural philosophy, there remained a number of seemingly miscellaneous topics, namely: mechanics, heat, sound, electricity, magnetism and light. These came to be called, collectively, Physics. Various attempts have been made by Einstein, to construct a unified theory which would include both gravitation and electromagnetic forces. Thus far, these efforts have not succeeded.

Physics, actually, is concerned with the scientific study of matters and energy. Energy is the most important aspect. Matters are studied only as they relate to energy. Like and as science, Physics can be seen in terms of product, processes, and ethics. The products of physics are facts, principles, theories, and laws that are commonly found in Physics textbooks. They are the results of long-standing and verified research efforts. They provide basis for description, explanation, deduction, prediction and applications of irregularities and regularities in nature. Further research activities can be stimulated by the products of physics. The Yorubas (a major tribesmen in

Nigeria), for instance, believe that thunderclap signifies the anger of the god of Iron or an object of god of iron has been misappropriated or stolen. Physics concept can be used to explain thunderclap. Physics, like science then, eliminates, objectively, superstitions. An individual, who has acquired the culture of Physics products like those of science, will become rational in thinking, action and judgment.

The product of Physics, like that of science, induces the development of deductive and inductive reasoning. The possession of inductive and deductive reasoning power enables an individual to argue logically, constructively, and objectively. Consequently, such an individual will be able to face challenges of advancing life.
Development of skills in problem-solving is the ultimate focus of learning.
The process of Physics has something to do with the activities of Physicists. Physics research, like that of any other separate science, requires several strategies such as problem identification, observation, classification, measurement, calibration, collection, recycling or replicating. A physics oriented mind is very curious, desirous of finding out, and interested in carrying out experiments. The processes of physics are precursors to the products of physics. Adequate exposure of human beings to processes and products of physics or science produces a socio-psychologically trained mind and consequently a better citizenry. The ethics aspect is the dos and don'ts of physics. It thus has something to do with morality. This is clearly seen in the applications of products of physics. Actually, physics should be separated from applications of physics. A physicist is not supposed to be motivated in doing his work by the application of the work. Out of curiosity, he came up with discoveries that have wide applications in terms of human comforts and sustenance. The destruction of human lives by the nuclear or atomic bomb early this century made some of the physicists involved to retrieve from active physics. It made them to become humanistic scientists as they opposed the use of the nuclear energy this way. It is not right to assign to physics or science all attributes of God. Science cannot solve all human problems.

Having dealt with physics as science subject and education which serves humanity as an end and a means to an end, we are now in a position to look at physics education. Physics education is best seen as education in physics. This is simply the teaching /learning and related research activities and publicity or dissemination that goes on in formal education system. The history of

physics is different from the history of physics education. The beginning and development of physics could be universal but that of physics education may vary from country to country.

Apart from teaching/learning, research and dissemination of physics in formal education system, physics education also involves promotion of physics literate society. From this perspective, physics education serves as the springboard for future career in physics and physics related subjects. Education in physics can also be seen as involving education about physics. Here, the products need not and cannot be specialists in physics but they will have enough knowledge of physics to help them appreciate work of physicist and what it is all about. It can help them to solve some physics or physics related everyday problems. The goals of physics education, like that of science education then, are:

- Production of physicists and educational physicists;
- Production of manpower needs in physics or physics related technology;
- Production of physics teachers; and
- Production of physics literate society, that is, a society that is well informed about physics.

6.13 What are the attributes of literacy in physics?

Literacy in physics, like literacy in science, liberates the mind from certain beliefs; superstitions and ways of life which are consistent with societal norms.

Ogunniyi (1988) assumed that a scientifically literate person should possess the under-listed abilities or capacities, i.e. ability or capacity to:

- Learn how to acquire necessary knowledge, skills and attitudes relating to Science;
- Distinguish as well as see the relationship between Science and Technology;
- Read scientific literature of general nature;
- Recognize the limitation of science;
- Distinguish between facts and superstitions;
- Use rational processes to solve problems;

- Appreciate the role of science and technology in the society;
- Search for objective facts rather than rely on rumors, taboos, Superstition and other authoritative generalization;
- Develop inquiry skills and problem-solving attitudes;
- Use scientific knowledge and skills for responsible social actions;
- Develop vocational competence in science and
- Recognize that science is a human enterprise.

The pay – off from scientific literacy is enormous not only for the individuals but for the entire nation. We are in the age of rapidly growing scientific and technological information and knowledge. If a person is not familiar with the changes in technology, he may not be able to operate relevant technological products, electronic wrist watches, for example.

From what has been said so far, it would be clear that the values of physics education like that of science education in general are the:

- Development of positive attitudes of life;
- Ability to think;
- Intrinsic interest it offers;
- Satisfaction of vocational motives;
- Acquisition of manipulative skills;
- Proper use of books;
- Development of clear expression;
- Development of attitudes of accuracy, honesty, skepticism, open mindedness, avoidance of dogmatism, humility and questioning of authorities.

6.2 Personal Contributions to Science Education in Nigeria

My area of Science is predominantly Physics. I was one of the pioneering students of science in my secondary school days. I was introduced to Physics through General Science in secondary two by an English literature teacher, Mr. Frenchum, as a separate subject in secondary class three and part of class four. He taught me Physics. He was a very hard working teacher quite alright but his knowledge of Physics was not much. As an enterprising teacher, in the absence of a Physics teacher he volunteered to take up the teaching because of his interest in introducing science into the school subject curricula. Through

his sole effort, the school was permitted to enter students for the ordinary level Cambridge Examination in Science through the West African Examinations Council.

To a few of us, he was our savior in terms of reading science generally and physics in particular but to the majority of our colleagues then, he had prevented them from studying science. I can vividly remember one of my colleagues, the retired Permanent Representative at the United Nation, Professor Ibrahim Gambari, who at that time used to pour curses on Mr. Frenchum, the physics teacher, as being responsible for his not studying science. Ladies and gentlemen, to be frank with you, although Mr. Frenchum did his best in introducing science into the school curricula, he was a very bad physics teacher. He was teaching physics as English literature. We know this because he was also our English Literature teacher. Before students got to his physics class, he would have filled the chalk board with notes on the topic to be taught. When students settled down in the class, he would start reading from the chalk board. Without explanation of any sort, he would call my name or another able student and asked, “Alright?” Once a very few of us said “yes”, he would continue reading. This was how I was taught Physics in the Secondary School I attended. During holidays, my colleagues from other schools had something similar to say about the way they were taught physics in their school.

After my undergraduate degree in physics, I taught Secondary School Physics in both lower and upper classes for a period of four years and College Physics for over ten years. The physics results in both West African and Higher School Certificate Examinations have not been satisfactory. This applies to the General Certificate of Education at ordinary and advanced level. This less than desirable performance has resulted in the long run, in a very few University graduates in Physics. The few that were qualified for entry into University usually prefer to read engineering degree Programmes. In the final analysis, few students completed their Secondary School education with a good knowledge of physics and those that have, usually finished with failures in the external examination. I was sad with this state of affairs in the learning of physics and I started thinking of what to do. The opportunity came when I was a teacher of Physics and mathematics in a College of Education after a few years of teaching the same subject in Secondary Schools, among which was St. Paul’s College, Wusasa Zaria. I had the opportunity of carrying out a survey

research on the “Teaching of Physics to mixed ability classes” with the aim of answering the following questions among others:

- Are students not genuinely interested in Physics?
- Do students run away from physics because of lack of enthusiasm?
- Are students forced to drop physics because of the school time table or because of lack of equipment?
- What are the methods used by the teachers of physics to raise the enthusiasm of their students?
- To what extent are the methods used successful?
- How can the methods be improved?

The following conclusions were made among others:

- Secondary Schools students found physics difficult because of the mathematics involved and because of the traditional way of presenting it (physics). Traditional presentation here means the pouring down of facts by teachers without students’ active participation. In the laboratory classes, students are given instructions on the experiments they are to carry out while the teacher goes round to help any student who is in difficulty;
- Some students have at the back of their minds the wide choice of careers that physics can provide without examining themselves well as to their ability to pursue the subject;
- Physics teaching is not encouraging to some schools because of lack of capable teachers and adequate equipment;
- The teaching/setting/marking examination system affects external examination results as it is not a coherent system;
- The teaching of any topic was not related to the everyday experiences of the students in the environment;
- Less mathematics would raise the interest of students;
- Teaching aids were not used by physics teachers apart from chalkboard;
- Students participation in classes was not encouraged;
- There was no continuity in Physics teacher’s services;
- Active participation of students should be encouraged in physics class activities during teaching. They should be allowed to ask question without any fear;

- Teachers should be exposed in education theories. Without this, his classroom experience is incomplete as he has little knowledge of the nature of his students; and
- The use of ability grouping could help in physics learning.

I tried to apply the conclusions of the study and the suggestions made in my teaching and related activities.

It was not long after the study that the opportunity of going to the United States of America (U.S.A) for a Doctorate degree study in Science Education came.

Before then, I was in U.S.A. under the sponsorship of Nigerian Federal Government and Ford Foundation. I visited and participate in most of the summer Institutes on the teaching of the new physics curriculum, the Project Physics. The project made use of activity method of teaching. I was so impressed with the method especially when I observed the amount of learning that was taking place with its use.

One of the causes of poor learning of physics which I discovered during the study I reported was the method of teaching. My experience with the Project Physics and both the course and field work for my Doctorate degree helped me in deciding to carry out a research study on "**A Comparative Study of the effectiveness of three methods of teaching Physics in Nigerian Secondary Schools"**. This was the research for my Doctorate degree in Science Education. I carried out the study in Nigeria after my course work in USA. After collecting all necessary Data, I went back to USA for collation, analysis, reporting and graduation.

The three methods involved are: Guided Inquiry, Traditional or Expository and Inquiry Role Approach (IRA). Inquiry method of teaching is a teaching process where student performs such mental operation as:

....measuring, predicting, observing, inferring and classifying plus those processes that characterize a mature scientist such as: formulating problems, hypothesizing, designing experiments, synthesizing knowledge, and demonstrating such attitudes as objectivity, curiosity, open-mindedness and respect for theoretical model (Sund and Trowbridge, 1973).

Guided Inquiry is therefore a type of inquiry teaching method characterized by a considerable structure. It is an approach to teaching whereby students are guided or assisted in a way in their learning activities so that they could arrive at a discovery. Any lesson prepared by the teacher has to be moderately structured. It is through the structuring that the required guidance is manifested.

A Guided Inquiry lesson has five components as follows:

- Concept to be developed. From the topic of the lesson, the teacher derives the important concepts he wants to develop; these will be listed;
- Materials required;
- Pre-activity discussion questions. These are usually questions which enable students to formulate hypotheses or expected outcomes of their inquiry activity;
- Students Discovery Activity. This consists of instructions and questions for the students in their investigation; and
- Open ended or Post-Activity Discussion questions.

  The first three Components are for the teachers use only, while the last three Components are to be produced for students.

A Guided Inquiry lesson uses several discovery processes, such as, observing, classifying, measuring, prediction and inferring. It also requires students to use inquiry abilities, such as; formulating hypotheses, designing experiments, and knowing some basics about some particular subject-matters. By the traditional method of teaching, we mean the expository or lecture method which is mostly teacher-centered. The teacher gives out information with little or no students' involvement in the teaching process. It is the oldest method of teaching. As a matter of fact, all innovations on teaching strategies are improvements on the use of traditional method of teaching.

Inquiry Role Approach (IRA) is defined as:

> ***...A structured and proven method of teaching science which results in students gain in knowledge of scientific principles and concepts, ability to formulate and resolve problems, communication and other skills necessary for working with people, and attitudes which are essential for participation in and interpretation of the process and product of science. (Bingam, Koutunk, Symour, Padberg and Bingman, 1969)***

Examples of the three teaching methods using the same experiment are shown in Appendix B.

Essentially, IRA involves the use of small groups with the assignment of roles to every individual member in each group. The use of small group process and roles are designed to help students assume more responsibilities for planning, managing and evaluating laboratory experience. The small group and role procedures enable students to develop social skills, problem-solving skills and attitudes necessary for self-direction. To properly handle inquiry instructional activities depends on a changed role of the teacher. He therefore must be concerned more with the students' skills and attitudes and less with subject-matter acquisition. The teacher becomes more of a facilitator and guider of learning process. He must know role definitions and reasons for using role. Whether or not the students succeed as "self-teachers" depends on the model projected by the teacher. In turn, this depends on the teacher's understanding of the concept of small group and role processes and his enthusiasm towards their use. Three groups of students were used for the Doctoral research. The experimental group I was taught Physics with guided Inquiry method, the experimental group II taught with Inquiry Role Approach and the control group taught with traditional method. The three groups were taught by me. Two measuring instruments constructed by me, the researcher, and validated by a panel of experts in Science Education and physics were used as pre and post-tests. These were: The students' Academic Achievement Test in Physics (SAAT) and the Self-Evaluation of Achievement Inventory (SEA). Ten (10) hypotheses stated in Null form were formulated and tested.

Based on findings or results of the study, the following conclusions were made:

- The three teaching methods, Traditional, Inquiry Role Approach and Guided Inquiry are equally effective in producing students' cognitive achievement gains in physics;
- Traditional method is more effective than Guided Inquiry method in developing students' feeling of cognitive achievement gains in physics; and
- There is a low but positive correlation between the Academic Achievement test and the Self-Evaluation of Achievement Inventory used.

Without any prejudice, the interpretation given to second conclusion was that the related finding was so probably because of the short duration of the associated teaching.

Nonetheless, research activities involving inquiry method continued.

Throughout the sixties, seventies and eighties, Inquiry teaching method reigned all over the world as a supplement to presentation of science subject matter to students. Although I used all forms of inquiry methods in Physics classes, they have also been successfully used in the teaching of Biology, Chemistry and even Mathematics. In the case of mathematics, inquiry method was adapted as Discovery method.

Under the auspices of the Science Teachers Association of Nigeria (STAN), I have directed and taught several Physics and Mathematics workshops using Inquiry method to supplement my teaching strategies.

I have trained many physics teachers in the use, merits and demerits of activity method of teaching. I have also presented and written several papers on the use of Inquiry method. This has cumulated into my writing of a book titled **"The Traditional and Inquiry Approaches to School Physics Practical (for Secondary Schools and Teachers' Colleges)"**

The method of Teaching, Inquiry Role Approach, as I used it in my research study was adopted in Scottish Secondary Schools through a popular Scottish Physics teacher, Jim Jardin. I got to know this when I was in Scotland in 1981. Many publications were made on my study in Scotland, I was in Moray College of Education, Edinburgh where Jim Jardin was teaching Physics. He gave me all publications on my study as used in High Schools in Scotland. Unfortunately, all these publications got burnt when my residence in Bauchi was involved in fire accident.

I have made communication as an inquirer and all associated behaviors and attitudes as a way of life.

As an educator and a college of Education Principal (provost), I have played prominent roles in Science Education. My experiences culminated into pioneering the establishment or introduction of undergraduate degree Programmes not only in Science Education (majoring in Physics, Chemistry, Biology and Mathematics) but also Social studies, Language arts and Business Education into the present Federal College of Education, Kano academic curricula. It is this experience I carried to the Abubakar Tafawa Balewa University, Bauchi about thirty years ago when it was a College of Ahmadu Bello University, Zaria.

At Abubakar Tafawa Balewa University, apart from my normal work as a teacher and a Head of Department. I served in several science bodies as paper presenter; consultant; Director of workshops, seminars etc; examiners, editors, assessor and researcher. This has continued until I was appointed as a Special Adviser in Science Education by the then Military Administrator of Bauchi state, Col. T. O. Bamigboye.

In this capacity, I have been opportuned to carry out a non-esoteric research in Science Education. It is in short, an Action Research. The Administrator has given me the assignment of going round all Secondary Schools in Bauchi State with the view to identifying all problems militating against good Science Education in the State. The goal is the improvement of Science Education in Bauchi State.

On my own, I summarized the assignment into a researchable problem titled **"Science Education in Bauchi State: Problems and Solutions"**. The assignment took me to Seventy three (73) Secondary Schools in the state as at 1996/97 school year. These schools comprised Government Science Secondary Schools, Government Arts Secondary Schools, Government Day Secondary Schools, Government Junior Secondary Schools, Government Technical Colleges and Government Vocational Training Centers. The Government Science Secondary Schools were subdivided into Special and other Science Secondary Schools. The study also covered the College of Education Azare and the Science Education Department of Abubakar Tafawa Balewa University, Bauchi. Data were collected about several aspects of the schools such as: Teachers' population, qualifications, teaching subjects, class taught, period of teaching per week, funding, boarding system, laboratory building and equipment, laboratory helps, classrooms, offices, Parent Teachers' Association activities, water and electricity supply, textbooks, library, staff development, incentives to teachers, etc.

Based on the analysis of Data, twenty six (26) conclusions were made as problems militating against good Science Education in Bauchi State. Since overall goal of the study is on the learning of Science and Mathematics, a spectacular conclusion was that "**the performance of Bauchi State Secondary Schools in Science and Mathematics at senior Schools Certificate Examination (SSCE) level was generally of low quality"** as at that time.

Based on the conclusions, 50 recommendations were made mostly for the attention of Bauchi State Government. A few ones were made for the attention of the Local Government and Parents. It is worth mentioning here that most of these recommendations were implemented by the energetic and progress loving Administrator, Colonel Theophilus Oladapo Bamigboye, now retired.

I also worked with the Bauchi State Government in the area of implementation of the State Policy on Education in general and Science Education in particular.

My contributions in Technology Education started with my involvement in a Master's Degree Programme in Electronics and Telecommunication Engineering of Ahmadu Bello University immediately after my B.Sc. (honours) Degree in Physics from the same University. As a result of coming out of the B.Sc. Programme as the best graduating student, I was awarded the University Scholarship for the M.Sc. study in electrical engineering. However, after successfully completing the course work I could not complete the Degree Programme until I travelled to U.S.A for a Graduate study under the Federal Government Scholarship and Ahmadu Bello University study Fellowship Scheme as a permanent Academic staff attached to the Institute of Education of the University. My contribution in Technology Education was reinforced when, after my tenure as Principal (provost) of the University's College of Education located in Kano, I was transferred to the young Science Education Programme at the Federal University of Technology, Bauchi.

I was to nurse and nurture the young Programme to become a full-fledged faculty. On successfully starting off the Science Education Programme, I embarked on a new Programme of Technology Education starting with Electrical/Electronic Technology Education. This was the best I could start with as a physics educator who has been exposed to electronics and Telecommunication Engineering.

It was not an easy affair as I was the only staff then who could teach a few courses in the Programme. I had no choice but to involve the academic staff of the Electrical Engineering Programme of the University. We took off and later included other technology education Programme, namely: Building, Automobile, Wood-Work and Metal-Work Technology. My first public outing in Technology Education was through the paper I presented at the Conference of Science Teachers Association of Nigeria (STAN) held at University of Ibadan in 1981. The title of the paper was **"Technological Take-off in Nigeria: Its implications for Science Education and the training of Science Teachers".** The paper was revised and presented again at the Conference of Science

Association of Nigeria (SAN) held at University of Ibadan in April 14-19, 1983. Since then, I have presented many key-note papers on Science and Technology Education at Conferences, Seminars and Workshops. I have trained many Science and Technology Education teachers scattered all over Nigeria.

I have served as a member of the governing council of Bauchi State Polytechnics and Bauchi State Directorate of Science and Technology.

The account of my contributions given so far is from my early education through my working life up to 1998. I remained at Abubakar Tafawa Balewa University as a visiting lecturer in the faculty of Technology Education up to the present time. In this capacity I serve as, Supervisors of some Masters and Ph.D. Degree students and teach mainly two courses up till present time. From 2007 when I retired from Abubakar Tafawa Balewa University, Bauchi, to September, 2011, I served as Director of Academic Planning at University of Mkar, Mkar Benue State.

From November, 2011 to date, I have been serving as Director, Academic Planning and Physics lecturer at Landmark University, Omu-Aran. I continue with my Science and Technology Education activities by participating in Book writing, Lecturing Professional and academic courses, Supervising Post – Graduate students in Science and Technology Education, serving Government Parastatals and Private organizations as consultants, Universities as External Examiners and assessor of Publications of intending Professors and Associate Professors, and serving Communities and Churches as an Elder citizen.

7.0 WAY FORWARD FOR SUCCESS IN AGRICULTURAL REVOLUTION AT LANDMARK UNIVERSITY

So far, I have been general in my treatment of Agricultural Revolution in relation to Science and Technology Education.

Let us now come back home to our situation at Landmark University Omu-aran. According to the Chancellor of Landmark University, Bishop (Dr) David Oyedepo, Revolution in general refers to **"Drastic measures to change things"**. Landmark University itself is a God's Project. To quote the Chancellor again;

> ***Landmark University was birthed as a vision and with a mandate to ignite an agrarian revolution in order to attain food security for our nation and continent. If there is one national issue today that stands out as a definite factor for almost all other critical challenges facing us and causing national and continental tension and crisis, it is the subject of food availability.***

Right from the onset of the University, the role of Science and Technology education in Agricultural Revolution was given its rightful place.
The University started with the college of Science and Engineering and Agricultural Sciences among others.
All Agricultural Science students study basic Sciences which are essential to Agricultural knowledge and practices. In the college of Engineering, the various knowledge areas of Technology education are taught to Agricultural Engineering Students as well. These areas are: Building, Woodwork, Metal work, Electricity and Electronics, and Automobile Technology.
Thus, Agricultural Revolution in the University started with relevant Science and Technology education.
The College of Business and Social Sciences has also been relevant to the Agricultural revolution particularly in marketing Agricultural products.
The revolution has been yielding expected dividends as the University has started marketing some Agricultural products such as chicken, eggs, maize, fish, and snails and so on. However, we need to sustain this while continuing with the revolution. There are two ways of taking care of the sustainability and continuity of the revolution. These are the immediate and long term ways or approaches.

7.1 The Immediate Way or Approach

Without wasting much time, I will just list the steps to follow;

1. The proprietors should continue to invest in their efforts to create an enabling environment for both staff and students of the University through
   A) Provision of essential teaching and research equipment and other facilities;
   B) Encouraging Staff, particularly Academic Staff, to attend learned conferences, workshops, seminars and symposia at local, national and international levels through sponsoring;
   C) Intensive sponsoring of research and development activities by academic staff. Research and development starts with research in its basic and applied forms. After any research output, relevant development should be encouraged through sponsoring; and
   D) Updating the various Academic Programme Curricular from time to time, particularly in the light of current changes globally.

2. The proprietors should try as much as possible to retain staff, particularly the academic scholars. I know this may not be easy but it is something possible even if extra fund is to be pumped in.

7.2. The Long-term Way or Approach

Here, we have to prepare future generation who will help to sustain all our present efforts. If the result of the revolution is to be maintained, we have to consider the school system.

Our environment should be seen as a World of its own. Education starts from the School system. We have Science and Technology education curricular right from Junior Secondary School section of our Basic education system. There is therefore the need for new curricular in Science and Technology.

Let us consider the case of United State of America where there was a great revolution in their Science and Technology system as a result of launching of the Sputnik Space-craft by Russia in 1957.

America took this up as a challenge. They immediately came up with the fact that they could only get solution by radically changing their Science and Technology education system right from their elementary schools. Although Nigerian education system is slightly different from that of America, particularly in their curricular, changes can still be made. While in Nigeria, our curricular from Primary or Elementary Schools to Senior Secondary Schools are centralized, there is nothing like that in America. Curricular are at best the same in a school District and not throughout a particular state.

America started with a revolution in her Science Education which resulted into needed changes in technology education.

New curricular in all science subjects emerged. The final result was the launching of American first space-craft. Although our revolution here is in Agriculture, we could attain the similar result through new Science Education curricular. As I said before, our schools curricular are centralized in Nigeria but we could enrich the common curricular in our schools (within the Living Faith Commission) so as to achieve the same result. My concern here is on the teachers who are to do this job. We need well prepared teachers of Science and Technological subjects. Presently in Nigeria, we seem to have many teachers of Science but few teachers of Technological subjects. I am putting much emphasis on these teachers because they are to teach the various science and technological subjects to children out of whom the new generation of undergraduates in the various Agricultural subjects will emerge. These

students will in turn be the sustainers of wherever the present generation stops in their efforts of food production and agriculture generally. Production of Science and Technology teachers is my Professional and Academic job. I have done this successfully for all the Northern States at tertiary education level including Masters and Doctoral degrees. There is hardly anywhere I go in Nigeria particularly the Northern including North Central zones that I will not see my products.

In other to sustain the agricultural revolution in Landmark University, we need these categories of teachers to bring up undergraduates and subsequently Post Graduate Students who would do the job.

In conclusion therefore, there is the need to introduce Science and Technology Teacher education as part of the academic Programmes of the University, even if it means sandwiching the Programme with the College of Science and Engineering to start with. I need not comment more on my ability to spearhead the exercise of teachers' production. I have all it takes to start and succeed in running the Programme.

Today, Faculty of Technology Education, my baby, is one of the flourishing Faculties at Abubakar Tafawa Balewa University, Bauchi.

It will be my pleasure to repeat the same feat in this University where I am a stake holder.

ACKNOWLEDGEMENT

Yes, I have done a lot in terms of human capacity building in education. I could not have done this alone; in fact it is impossible for me alone. It is therefore necessary to show appreciation to those who have built me up. First of all, I give thanks to the Almighty God for always be behind me in everything I do, He is the Ancient of days, He was, and He is and would continue to be. To Him be the glory.

The lecture would not have been possible if I am not in the University. I value it because it has added to my credibility and hence worth.

I give my thanks to His Grace, Papa Bishop (Dr.) David Oyedepo. I have not been chanced to express my gratitude to him. This is my chance. I know the role He played in bringing me to Landmark University. I know I am here on His request. May God continue to be with Him in His Ministry. Next is the Pro Chancellor, Pastor Yemi Nathaniel. I got to know him at Landmark University, I have been watching him in all his activities and utterances, I like him for his strong passion on spiritual and related matters. A very bold, fearless and non-

apologetic man when it comes to spiritual matters. Whenever we meet, I could feel his genuine respect for me. Thank you sir, for this. I have expressed my gratitude to my immediate past Vice Chancellor of this University, Professor, Mathew Rotimi Ajayi at the beginning of this lecture. He is a very humble man; He has encouraged me in all my activities at Landmark University.

I like to thank my Ag. Vice Chancellor, Professor Afolayan for his humility and respect for me. To the current Registrar, Pastor (Dr.) Daniel Rotimi, I say thank you for your respect for me. Actually, I began to know you well when you reported here as the Registrar. I do not forget my immediate past amiable Registrar, Pastor (Dr.) John Izebere, for the love and respect he displayed to me whenever we are together. These gestures contribute a lot to my well-being in Landmark University.

What of all my colleagues and friends here in Landmark University: Professors Adeniyi, Atoyebi, Oyawoye, Olatunji, Owa, Fajinmi and a host of others. They have contributed to my well-being here in Landmark University. My gratitude also goes to our staff in the Academic Planning Directorate, Physical Science Department and Physics Programme. They have all contributed to the success of this lecture in ways I cannot quantify.

I cannot forget my past mentors and associates who have played vital roles in my life. Some of these people are: Late Professor Albert Ogunsola, former Director of institute of Education, Ahmadu Bello University and Deputy Vice Chancellor (ABU) Zaria; Professor Timothy Afolayan, a former Principal (Provost) of ABU College of Education; Kano, Professor Jonathan Ndagi, a former Director of Institute of Education, ABU, Zaria and first Vice Chancellor of Federal University of Technology, Minna and Professor Samuel Aleyideino, a former Director of the Institute of Education and Dean, Faculty of Education, Ahmadu Bello University, Zaria. I am a Professor today as a result of my resolve to be like them. They were all great teachers.

I do remember my friend, Professor Buba Bajoga, an Electrical Engineering of note. He actually brought me to Abubakar Tafawa Balewa University (Formerly Federal University of Technology) Bauchi where I became a Professor. I spent good and successful twenty three years in Bauchi. Professor Bajoga invited me to come and bring up a young Science Education Programme. This I did by nursing and nurturing the young Programme to an enviable faculty of Technology Education that specialize in the production of Teachers of Sciences, Vocational and Technological Disciplines.

I thank all my secretaries, Office Assistants, and Administrative Officers in the various places I worked. They have helped me in all my writings.

I must remember my late wife, Mrs. Rebecca Mopelola Olarinoye (Nee Adelere) a native of Idofian. She was a great stenographer and very good in short hand writing. You hardly see a Professional personal secretary like her today.

She has been a good friend and partner. I cannot forget her in life for I always remember the way and manner she tolerated me in our youthful age. She is gone but her memory lingers on as her six children are all alive and doing well. The youngest of them, a boy, is thirty three years old and is happily married.

I cannot forget my present wife. She has been very supportive.

To my children, I say, thank you for making me happy.

To all Kings and Queens of Landmark University, I say thank you all. May God be with you in your studies.

In closing this section of acknowledgement, let me express my gratitude to my very good secondary school student, Col (RTD) Theophilus Bamigboye from Omu-Aran town. He has always been nice to me. He appointed me as a Special Adviser in Science Education for Bauchi State Government when he was the Military Administrator of Bauchi State. I can remember the opposition he faced on this appointment and how he stood firm on his decision. He is still fond of me as I am fond of him too. I thank him for his respect always. In fact, he sponsored my Inaugural Lecture in 1998 at Abubakar Tafawa Balewa University, Bauchi.

Mr. Chairman, ladies and gentlemen, I rest my case here. Thank you for listening.

REFERENCES

1. FISHER, R. (1975). Science, Man and Society. W.B., Saunders Company, Philadelphia, London and Toronto.
2. OLARINOYE, R.D. (1998). Science Education in Nigeria Yesterday, Today and Tomorrow: Trends and Developments. An Inaugural lecture delivered at Abubakar Tafawa Balewa University, Bauchi, April, 22nd
3. OLARINOYE, R.D (2014) Contributions of the Private Sector to Science and Technology Education in Nigeria, a chapter in the Book titled "Education in Nigeria: Development and Challenges" edited by N.A. Nwagwu and U.M.O Ivowi.
4. OLARINOYE, R.D (1978). A Comparative study of the effectiveness of three methods of teaching a secondary school Physics course in a Nigerian secondary school. A Dissertation submitted in partial fulfillment of the requirements for the Degree of Doctor of Education of the Department of Science Education, College of Arts and Sciences, University of Northern Colorado, Greeley, Colorado, USA.
5. OLARINOYE, R.D (2014). Peace Education in Science and Technology. A paper submitted for publication in the Year Book, No.7 of the Nigerian Academy of Education.
6. BISHOP (Dr.) OYEDEPO (2014): State of the University (Landmark University, Omu-Aran, Kwara State). An Address delivered as Chancellor of the University at the World Press Conference marking the Maiden Convocation Ceremony. Wednesday, 23rd July.

APPENDICES

APPENDIX A

ELEMENTS OF SCIENTIFIC LITERACY:

A TWO DIMENSIONAL GRID USED IN THE ORGANIZATION OF SCIENCE OBJECTIVES

Elements	Fundamental Aspects of Science

OBJECTIVES	Concepts	Principles	Conceptual Schemes	Inquiry Skills	The Scientific Enterprise
Understanding and Applying Appreciation of					

APPENDIX B

EXAMPLES OF THE FOLLOWING METHODS OF TEACHING PHYSICS USING THE SAME EXPERIMENTS:

1. **Inquiry Role Approach (IRA)**
2. **Traditional Method**
3. **Guided Inquiry Method.**

THE EXPERIMENT

Determination of the Relationship between Electric Current through a wire and the Potential Difference across any two points of the wire (Simple Treatment)

INQUIRY ROLE APPROACH (IRA)

Name: _____

Activity: The Experiment

Section: Technical Advisor's Delegation Sheet

Summary: Use this delegation sheet to divide the laboratory exercise and to direct the execution of the exercise.

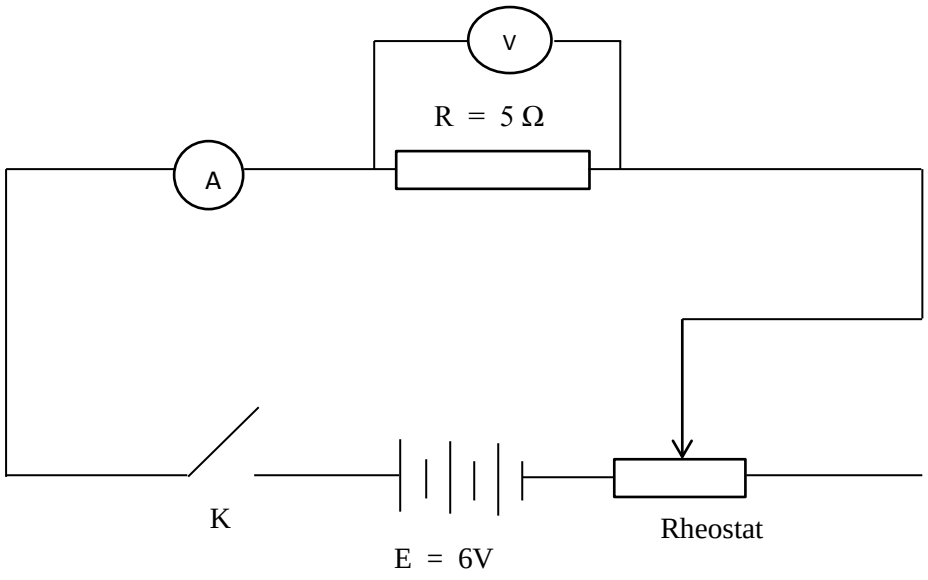
Preparing Materials:

Team Coordinator: 1. A 6V D.C. battery, circuit key.

Process Advisor: 2. Copper wires

Technical Advisor: 3. Ammeter, voltmeter

Data Recorder: 4. Rheostat and a fixed resistor (5 ohms)



K – circuit switch or key

E – accumulator

A – ammeter

V – voltmeter

Technical Advisor: 5. Make up the above circuit while others watch and advise as necessary. Leave K open as in diagram and call your teacher's attention for checking the circuit.

Process Advisor: 6. Adjust the rheostat to the maximum and then close K.

Data Recorder: 7. Record the readings of the ammeter A and voltmeter V.

Team Coordinator: 8. Vary the rheostat while the data recorder records I (current) and V (voltage) as indicated by A and V respectively. Obtain about 10 values of each of I and V.

Data Recorder: 9. Record the value of R.

Cleaning Lab

Team Coordinator: 10. Return the battery and circuit key.

Process Advisor: 11. Return the copper wires.

Technical Advisor: 12. Return the ammeter and voltmeter.

Data Recorder: 13. Return the rheostat and the fixed resistor.

Name: _____

Activity: The Experiment

Section: Data Recorder's Data Sheet

Summary: Use the data sheet to record all observation your group makes (data) in an organized way.

Title of Experiment:

Purpose of Experiment:

DATA TABLE

Current Voltage	Voltage	Current	
I (Amp) (Volt)	V (Volt)	I (Amp)	V

R =

Other Observation:

Conclusion:

Name: _____

Activity: The Experiment

Section: Discussion, Coordinator's Report Questions

Summary: Lead a group discussion, making sure all members participate.

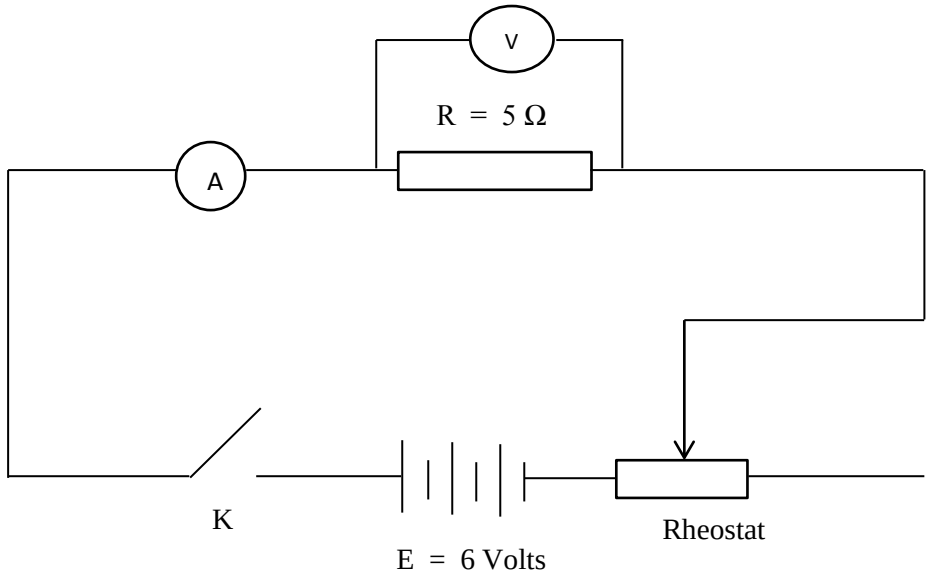
1. How shall we use the data collected to investigate the required relationship between I and V? (Pause for suggestion.) Team can then start plotting the graph of V as ordinate against I as abscissae – choosing appropriate scale.
2. What conclusion could we draw from the graph?
3. What is the slope of the graph? (Compare this with the value of R).
4. Why do you think it was necessary to leave the key K, open initially?
5. Why was it necessary to adjust the rheostat to its maximum value before closing K?
6. What other circuit connections would you use to obtain the same result?
7. If you were to repeat the experiment with the same circuit, how would you modify this to obtain better data?
8. What generalization would you make from the experiment?
9. What other data could you obtain from the circuit perhaps with little modification?
10. What additional comment would you like to make about the experiment?

TRADITIONAL METHOD

Aim: To determine the relationship between electrical current through a wire and the potential difference across any two points of the wire.

Apparatus: 6 V D.C. battery, copper wires (insulated), ammeter, voltmeter and a rheostat.

Method:



K – circuit switch or key

E – accumulator

A – ammeter

V – voltmeter

A. Make up the above electrical circuit. Leave K open as in the diagram and call your teacher's attention for checking the circuit.
B. Adjust the rheostat to the maximum and then close K.
C. Record the readings of the ammeter A and voltmeter V.
D. Vary the rheostat and record the readings of A and V.

E. Repeat this to obtain about 10 values of the current and A and V respectively. Record the value of R.

Treatment of Data:

1. Tabulate the values of I (current) and V (voltage).
2. Plot a graph of V as ordinate and I as abscissae choosing a suitable scale.
3. Determine the slope of your graph and compare this with R.
4. Draw a conclusion concerning the relationship between I and V.

GUIDED INQUIRY METHOD

Relationship between electric current through a wire and the potential difference across any two points of the wire (simple treatment).

Concepts:

Electric current (direct), potential difference, electromotive force, electrical measurement, electric circuit, electrical conductors, insulators, resistance, Ohms Law of electricity.

Materials:

A 6 volt D.C. battery. Copper wires (insulated), ammeter, voltmeter, rheostat, a fixed resistance, a circuit key, cotton thread.

Pre-Lab. Discussion:

Hypothesizing	1.	What do you think will happen to the current as the rheostat is varied?
Hypothesizing	2.	What do you think will happen to the voltage as the rheostat is varied?
Hypothesizing and	3.	What property of the rheostat do you think make (1) (2) possible?
Hypothesizing touch	4.	If the connecting wires were not insulated and they on closing the key, what do you think will happen?
Hypothesizing on,	5.	If you touch the uninsulated wire when the current is what do you think will happen to you?

Hypothesizing 6. What type of relationship do you expect between current

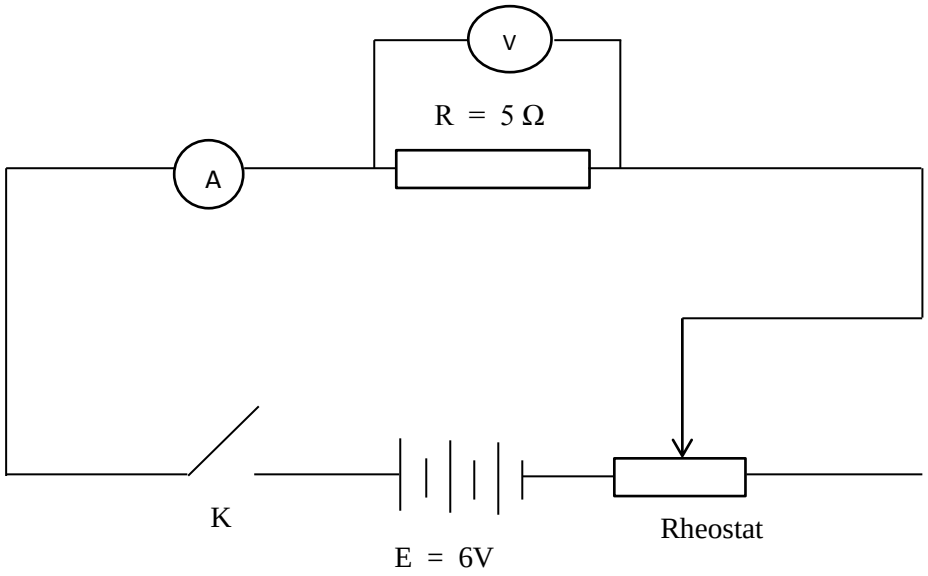
and voltage across the fixed resistor?

Hypothesizing 7. What do you think is the purpose of the fixed resistor?

Students' Activities:

Process

Collecting equipment 1. Obtain the following equipment: A 6 volt D.C. wet battery (accumulator), 6 short lengths of insulated copper wire, ammeter, voltmeter, rheostat, and a 5 ohm resistor.



K – circuit switch or key

E – accumulator

A – ammeter

V – voltmeter

Following apparatus direction in 2. If you can think of no alternative assembly of other than the above diagram, make all connections as the diagram. Leave the key K open.

Following direction	3.	After the teacher has checked your connections, adjust the rheostat to the maximum and then close K.
Observing	4.	What happens to the ammeter A and the voltmeter V?
Recording	5.	Record your observations in 4.
Following direction and recording	6.	Vary the rheostat and record the values of I and V.
	7.	Repeat (6) to obtain about 10 value of I and V.
Recording	8.	Record the value of r.
Recording	9.	Record the values of V and I (current) in tabular form.
Plotting graph choosing and inferring	10.	Plot a graph of V as ordinate and I as abscissae a suitable scale. What type of curve do you obtain?
Inferring	11.	What conclusion can you draw from the graph?
Inferring	12.	What is the slope of your graph?
Comparing	13.	Compare this slope with the value of R.

Post-Lab. Discussion:
Open-ended question

Process		
Hypothesizing	1.	What do you think the slope of the graph is?
Hypothesizing	2.	Why do you think it is necessary to leave the key, K, open initially?
Hypothesizing	3.	Why is it necessary to adjust the rheostat to its maximum value before closing K?

Designing apparatus	4.	What other circuit connections would you use to obtain the same result?
Evaluating	5.	If you were to repeat the experiment with the same circuit, how would you modify this to obtain better data?
Evaluating	6.	What generalization can you make from the experiment?
Designing an investigation	7.	What other data can you obtain from the circuit, perhaps with little modification?

BRIEF PROFILE OF PROFESSOR R.D. OLARINOYE

Professor Raphael Dele Olarinoye was born about 74 years ago at Omupo in Kwara State to a couple, Mr. Emmanuel Amoo Olarinoye and Mrs. Felicia Akanke Olarinoye. He attended St. Michael's Primary School, Omupo from January 1950 to December 1957 for his first School Leaving Certificate and Provincial Secondary School, Ilorin (1958 to December, 1962) for his Secondary School education. Thereafter, as a result of sixth form entrance examination of the West African Examination Council, he was posted to Federal Emergency School of Science in Lagos for his GCE/AL (January 1963 – December, 1964). After passing the A/L examination, he entered Ahmadu Bello University in September 1965 to read Physics at B.Sc. Degree level. He passed his B.Sc. (Hons) degree in Physics in June 1968 with a Second Class Honours Division. With the award of Ahmadu Bello University Post- Graduate Scholarship, he studied Advanced Electronics and Telecommunication in the same University. He later studied for a Post-Graduate Diploma in Education 1973/74 in the same University.

In 1975, under the Federal Government Scholarship and Ahmadu Bello University Study Fellowship Schemes, he travelled to the United State of America for his Doctorate Degree, which he successfully completed in August 1978.

After his first degree in physics, Professor Olarinoye started the second leg of his working career in St. Paul's College, Wusasa, Zaria as a Physics and Mathematics teacher. He later served as the head of Physics Department and a housemaster in the college. Heleft the service of the College in 1971 for a Lecturer II post at the Institute of Education, Ahmadu Bello University, Zaria with assignment at a constituent college, Advanced Teachers' College, Kano. He served in the College as a teacher, head of Physics Department; head of Division of Science, now refered to as Director or Dean); Vice Principal, now refered to as Deputy Provost; Principal , now refered to as Provost; and head of degree programme at the College. He started the degree programme in the College. He was transferred to Abubakar Tafawa Balewa College, Bauchi (Later Abubakar Tafawa Balewa University of Technology) in 1984. Here, he started the Science Education Programme as the Coordinator, nursed and nurtured it till 1999. He has been an Associate Professor in 1984 and a Professor of Science

Education since October, 1990. He has served in several capacities in the University: Coordinator; Hall Warden; member, University Senate; Chairman, Industrial Training Coordinating Committee; Chairman; Examination Committee; Chairman, Technology Teacher Training Programme; member, Appointment and Promotion Committee; Chairman, Research and Publication Committee and member, University Governing Council to mention a few. Professor Olarinoye has served both States and Federal Governments, NGO, Government Parastatals as consultant; a special case is his service as Special Adviser and Consultant in Science Education to Bauchi State Government under the government of Col.(RTD) Theophilus Oladapo Bamigboye. Earlier, he served the same Bauchi State Government as a member of Governing Council of the State Polytechnic and Directorate of Science and Technology. He has also served many Universities and Colleges of Education as external Examiner and Assessor for promotion and appointment. He belongs to several professional bodies among which are: Science Teachers Association of Nigeria (STAN), Science Association of Nigeria (SAN); Curriculum Organization of Nigeria (CON); Nigeria Academy of Education (NAE); Institute of Physics (IOP), United Kingdom and Nigeria; Association for Science Education (ASE), United Kingdom; and Nigeria Institute of Corporate Administration (CAI). He was the President of Curriculum Organization of Nigeria for four consecutive years. He has several honours and awards among which are: Best Student in Mathematics, Physics and History in Secondary School; Imperial Chemical Industry Prize for the best graduating student in Physics (1968); University and Federal Government Scholar; Fellow of Science Teachers Association of Nigeria (FSTAN); Fellow of Curriculum Organization of Nigeria (FCON); Fellow of Institute of Administrative Management of Nigeria (FIAMN); Certified Distinguished Administrator; Fellow of Nigeria Academy of Education (FNAE); Fellow of the Institute of Corporate Administration (FCAI); who is who in Kwara State, who is who in Nigeria; who is who in Science and Technology education in Africa and a Chartered Physicist, U.K.

Professor Olarinoye is a devoted Christian of Anglican denomination. He served as the Chairman of the Implementation committee of the Missionary Anglican Diocese of Bauchi. He was the first Lay Synod Secretary of Kano Diocese before moving to Bauchi. With the inauguration of Bauchi Diocese, he became the first Project adviser and later the Education Adviser. In the later capacity, he prepared the education policy and a handbook of general information to Secondary School students of the Diocese. He is currently a Diocesan official of Igbomina Diocese in Kwara State.He is a Jerusalem Pilgrim (JP).

Professor Olarinoye is also a community leader. He served as the Chairman of his community (Igbomina/Ekiti) in Bauchi for over ten years. In recognition of his role in the Socio-economic development of his home community, Omupo-Land, he was honoured with a Chieftaincy title of Otun-Basorun. After putting in over 35 years of meritorious service in Nigerian University system, he retired as a Professor and Dean of Science and Technology Education on 30th June, 2007. As he is not tired, he is presently a Professor in the Department of Physics, Landmark University, Omu Aran after serving for four years as the Director of Academic Planning of University of Mkar, Mkar in Benue State He is also presently the Director of Academic Planning in Landmark University, Omu-Aran. He is a Visiting Professor of Abubakar Tafawa Balewa University, Bauchi and a consultant to ECOWAS.

Professor Olarinoye has over 120 published articles, conference papers, books and Book Chapters to his credit. As a lover of peace, he was honoured with the title, Ambassador for Peace (AFP) by Universal Peace Federation (UPF), an Inter-religious and International Federation for World peace. He is married with children.