

Module 4	<i>SOCIAL STUDIES AND THE CONCEPTS OF SCIENCE AND TECHNOLOGY</i>	
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SOCIAL STUDIES AND THE CONCEPTS OF SCIENCE AND TECHNOLOGY

OVERVIEW

Social Studies is a dynamic discipline with an abiding interest in the changes that man had brought about in the past, and the effects of these on human endeavours in present day. Tremendous changes had occurred in society as a result of human invention in science and technology. This module highlights the origins of those changes, their growth and development, partly to inculcate in learners an awareness of the changes around them, and also to be sensitive to their dangers and advantages. The modules place a premium on an important goal of Social Studies, namely, the need to come to rational and objective decisions and judgment based on solid data and information.

UNIT 1: CONCEPTS OF SCIENCE AND TECHNOLOGY

INTRODUCTION

Globally, science and technology have brought enormous changes into different parts of the world in several areas of human endeavour. But before we go further, let us as ourselves: What is science? What is technology? How did these areas of human activity originate? What were their roots in traditional society?

In this unit, you will learn about the concepts of science and technology and how they grew out of traditional science and technology. This leads on to our consideration of modern science and technology. At the end of the unit, you would have to obtained answers to the questions posed in this introduction.

OBJECTIVES

At the end of this unit, you should be able to:

- (i) define the concepts of science and technology;
- (ii) describe traditional science and technology; and
- (iii) define modern science and technology.

HOW TO STUDY THIS UNIT

1. Glance through the unit. Note the salient points as you read. Take note of the unfamiliar words and check for their meanings in your dictionary.
2. Now from the beginning, read and digest the unit thoroughly and systematically as arranged. Make sure you attempt all the activities stated. Before attempting the exercises, avoid looking at the answers provided.
3. Make sure the rules stated are strictly adhered to.

WORD STUDY

Science	-	knowledge that can be proved through experiments.
Technology	-	Practical application of scientific knowledge.
Modern technology	-	new or progressive application of scientific knowledge.
Modern	-	Something new.
Modernity	-	the condition of being new.
Modernization	-	the process of making something new.
Traditional technology-	-	old or obsolete application of scientific knowledge.

CONCEPTS OF SCIENCE, TECHNOLOGY AND SUPERSTITION

Science is the study of the structure and behaviour of physical and natural world and society especially through observation and experiment. It is also the knowledge that is gained after following a definite process. Science presumes that the things and events in the universe occur in consistent patterns that are comprehensible through careful, systematic study. Scientists believe that through the use of intellect, and with the aid of instruments that extend the senses, people can discover patterns in all of nature.

Over the course of human history, people have developed many interconnected and validated ideas about the physical, biological, psychological and social worlds. These ideas have enabled successive generations to achieve an increasingly comprehensive and reliable understanding of the human species and its environment. The means used to develop these ideas are particular ways of observing, thinking, experimenting and validating. These ways represent a fundamental aspect of the nature of science and reflect how science tends to differ from other modes of knowing (UNESCO 2000).

Furthermore, conceptually science assumes that the universe is, as its name implies, a vast single system in which the basic rules are everywhere the same. Knowledge gained from studying one part of the universe is applicable to other parts. For instance, the same principles of motion and gravitation that explain the motion of falling objects on the surface of the earth also explain the motion of the moon and the planets. However, with some modifications over the years, the same principles of motion have been applied to other forces and to the motion of every thing, from the smallest nuclear particles to the most massive stars, from sail-boats to space vehicles and from bullets to light rays.

Science in concept has the following characteristics:

1. **Scientific ideas are subject to change:** This connotes that science is a process for producing knowledge. Change in knowledge is inevitable because new observations may challenge prevailing theories.
2. **Scientific knowledge is durable:** This implies that, the modification of ideas, rather than their outright rejection, is the norm in science as powerful constructs tend to survive and grow more precise and to become widely accepted. Therefore, continuity and stability are as characteristic of science as change is, and confidence is as prevalent as tentativeness.
3. **Science cannot provide complete answers to all questions:** Many matters cannot be examined in a scientific way such as the existence of supernatural power and beings, or the true purposes of life. Moreover, a scientific approach that may be valid is likely to be rejected as irrelevant by the people who hold to certain beliefs such as in miracles, fortune telling, astrology and superstition. So also, scientists have no means to settle issues concerning good and evil, although they can sometimes contribute to the discussion of such issues by identifying the likely consequences of particular actions, which may be helpful in weighing alternatives.

4. **Science demand evidence:** This means that the validity of scientific claims is settled by referring to observations of phenomena. Evidence is obtained by observation and measurement taken in situations that range from natural settings (such as forest) to completely contrived ones (such as the laboratory).
5. **Science is a blend of logic and imagination:** That is, scientists tend to agree about the principles of logical reasoning that connect the evidence and assumptions with conclusion.
6. **Science explains and predicts:** That is, based on the existing scientific principle, scientists observe and come up with useful explanations for future prediction.
7. **Scientists try to identify and avoid bias:** In science the possible sources of bias are identified and how bias is likely to influence evidence.
8. **Science is not authoritarian:** that is, there are no pre-established conclusions that scientists must reach on the basis of their investigations.

Now what is Technology: It is the application of the scientific knowledge to make things work for the greater happiness of mankind. It is a pre-requisite for the growth and in all spheres of human endeavours is employed by the technologists. However, science and technology have arrived at the following processes.

- (i) Observation.
- (ii) Collection of information.
- (iii) Collation of information.
- (iv) Analysis of information.
- (v) Conclusion and recommendation.

By and large, it is the science that deals with the invention while the technology deals with the applicability of the invented products. For instance, through science, electricity was invented, it is technology that enables the use of the electricity for cooling, preserving, cooking, welding, heating, etc. In other words, science and technology work together for the benefit of mankind.

TRADITIONAL SCIENCE AND TECHNOLOGY

Before the advent of the modern science and technology, people who lived in the traditional societies had their own science and technology. For instance, these people engaged in gathering of fruits by wandering in the bush and even hunting for animals using clubs, arrows, and stone s and later dane guns and catapult. Initially, they ate the animals killed raw but later with the discovery of fire through the scratching of stone with stone they started cooking their food through the use of fire. They engaged in the domestication of animals through fringe range, cultivation of crops by the use of “crude” implements such as hoes, cutlasses etc. and in fact, they engaged in preventive and curative medication through the use of herbs.

Therefore, in the tool making, building construction, pottery, fire lighting, bronze casting, iron smelting, sculpture, basket weaving, leathery, black-smithing, mat weaving among others are the products of traditional science and technology, most especially in African societies and particularly in traditional Nigeria society.

DEVELOPMENT OF MODERN SCIENCE AND TECHNOLOGY

Modern science and technology was developed from the traditional science and technology as a result of the recognition that the cultural world around the man today is based mostly on the application of the scientific knowledge, that is, technology. Moreso, science has become less visible and yet to obtain a new technological literate society, there is need for people to receive a more relevant grounding in science. This grounding involves the new technology that surrounds them and in addition, the issues and conflicts that are related to the use of that new technology in the society. This leads to the development of the science related to that technology and to an informed opinion on the likely benefits and problems of promoting various technologies. It also leads to recognition of problems, of considerations of how to solve problems and an ability to make decisions based on sound judgment.

In the development of modern science and technology, emphasis is laid on responsible decision-making concerning any issue in the real world of the learner whereby the learner considers the following:

- (a) Is it a problem?
- (b) How did it become a problem?
- (c) What are some alternative approaches to its solutions?
- (d) What are the potential effects of applying the alternatives on individuals and/or society?

Solutions to such questions are necessary because of the role modern science and technology are playing in the environment and the need to combat the very negative ideas about science and technology because of issues such as pollution, social concerns and fears.

Furthermore, the modern science and technology, creates a techno-scientific awareness in individuals concerned in the society in which they live. Thus, they develop the ability to think or analyse situations in the society critically and resolve them effectively by techno-scientific strategies.

Moreover, the development of modern science and technology is to inculcate in the citizenry the abilities to:

- (i) use concepts from science and technology and ethical values in the solving everyday problems and making responsible decisions in everyday life, including work and leisure;
- (ii) defend decisions and actions using rational arguments based on evidence;
- (iii) distinguish between scientific evidence and personal opinion and between reliable and unreliable information.

- (iv) engage in responsible personal and civic actions after weighing the possible consequences of alternative options.
- (v) locate, collect, analyse and evaluate sources of scientific and technological information.
- (vi) use these sources in solving problems, making decisions and taking actions.
- (vii) offer explanations of natural phenomena which may be tested for their validity.
- (viii) value scientific research and technology problem solving.
- (ix) Remain open to new evidence and the tentativeness of scientific knowledge. (Yager 1992).

However, the scope of modern science and technology involves:

SCIENCE	TECHNOLOGY
<ul style="list-style-type: none"> • Biology • Astronomy • Chemistry • Geology • Physics 	<ul style="list-style-type: none"> • Agriculture • Automation and Computer • Biotechnology • Chemical technology • Communication • Construction • Military • Power and Fuel • Space • Transportation

By and large, the development of modern science and technology has contributed immensely to the following global issues: armament, nuclear proliferation, global warming, toxic waste management, cloning and information technology. These issues have both positive and negative impact on mankind.

ACTIVITY

1. Define science and technology
2. Explain briefly the development of modern science and technology.

SUMMARY

- Science is the knowledge acquired through observation and experimentation of physical and natural phenomena while technology is the application of the scientific knowledge for man's comfortability and happiness. Both make use of certain processes viz. observation, collection of information, gathering of information, information analysis and conclusion and recommendation.

ASSIGNMENT

1. "An evil to modern society". Do you agree with this assessment of the role of science and technology to your society?

REFERENCES

- UNESCO (1999) **Declaration on Science and the Use of Scientific Knowledge**. Text adopted by the World Conference on Science at Budapest, Hungary.
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UNIT 2: EFFECTS OF SCIENCE AND TECHNOLOGY

INTRODUCTION

Science and technology have contributed immensely to all fields of human endeavour such as medicine, communication, transportation, agriculture, industrialization, construction energy production, space exploration and exploitation, warfare to mention just a few. At the same time, science and technology have created a lot of problems for mankind such as environmental degradation, pollutions, (air, water and land) production of dangerous gas and weapons of mass destruction, destruction of the ozone layer, and vital accidents in transportation (land, air and sea). In this unit, the dangers and benefits of science and technology are presented. You should watch out for any of this effects that may have touched your life and those of your community.

OBJECTIVES

At the end of this unit, you should be able to:

- (i) discuss at least five positive effects of science and technology.
- (ii) explain at least four problems created by science and technology for mankind.

HOW TO STUDY THIS UNIT

1. Glance through the unit. Note the salient points as you read. Take note of the unfamiliar words and check for their meanings in your dictionary.
2. Now from the beginning, read and digest the unit thoroughly and systematically as arranged. Make sure you attempt all the activities stated. Before attempting the exercises, avoid looking at the answers provided.
3. Make sure the rules stated as strictly adhered to.

WORD STUDY

Culture	:	-	way of life of a group of people.
Delimitations:		-	benefits derived from something
Environmental degradation:-		-	the process of making environment worse.
Human endeavours:		-	human undertakings or attempts.
Limitations:		-	problems or limiting factors.
Ozone layer:		-	a layer in the sky that is protecting the earth from the direct sunrays.
Pollution:		-	contamination of the environment through harmful gasses or chemicals.
Space Exploitation		-	development in the sky for man's benefits.

Space Exploration - discovery in the sky.

EFFECTS OF SCIENCE AND TECHNOLOGY OF MAN AND HIS CULTURE

Science – Technology and Culture (society) mostly implies the application of science through technology to break the shackles that bind man with his cultural setting (society), This interaction is diagrammatically represented thus:

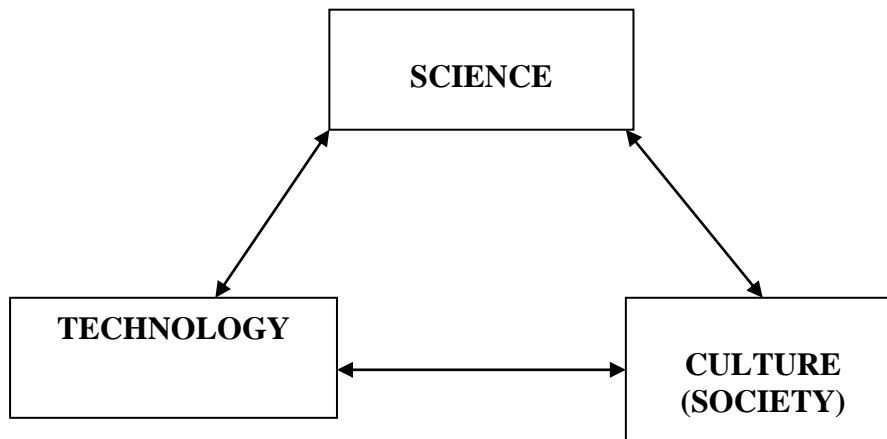


Fig. 2.9 *Diagrammatical Illustration of Science, Technology and Culture (Society)*

In Fig 2.9, it can be inferred that man in quest of making life easier for himself in his cultural settings (society), he has applied the knowledge of science to produce goods that facilitate his life in all areas of his endeavours such as medicine, food power generation, transportation, communications and so on. (Awosika, 1977). Therefore, it connotes that technology is the means used to apply the fundamental truths of science to the solution of the physical, biological or economic problems of man.

Therefore, science and technology have produced incalculable materials benefits for man in his cultural settings or society. These include:

1. **Increase in food supply:** In the technological successes achieved, the most outstanding one is probably the increase and stabilization of the food supply through the application of machinery and power fertilizers and pesticides, hybridization and processing techniques.
2. **Increase in life span:** The increase in food supply enhanced by the medical pharmaceutical sanitation revolution have brought about rapid increase in life spans which result to astronomical increase in population.
3. The following remarkable effects are also noticed on men's culture through science and technology:
 - (i) It saves labour.

- (ii) It has greatly reduced the cost of manufactured commodities through mass production techniques.
- (iii) It has led to great improvement in literacy and educational levels.
- (iv) It has brought about increased convenience and environment – communication revolution.
- (v) It changes the structure of the social class in the society.

In fact, the effect of science and technology on the man's culture (society) has given rise to new elite class known as the "Manager of Society" whose power is not from traditional class sources. These managers of society are often recognized by their nucleated offices harbouring different sizes of gadgets such as computers, E-mail facilities, facsimile machines, many types of telephones. In some cases they possess the internet system that enables one to obtain current information on virtually ever conceivable event or publication. Often, they are decision-makers in the upper chambers of public and private bureaucracies spanned by technology.

PROBLEMS CREATED BY SCIENCE TECHNOLOGY

In quest of making his cultural setting to be more comfortable to him, man has made use of scientific applications (technology) which has resulted into many unforeseen negative impacts or problems such as population problems social difficulties, ecological problems and nuclear warfare.

- (i) **Population Problems:** The advancement in medical technology has brought about the alarming rate in population increase which is now a great threat to life on the earth. This has resulted into many socio-cultural problems viz: food shortage, overcrowding, unemployment. Deforestation, over-cultivation, overgrazing, drug addition or abuse, cultism, armed robbery and so on.
- (i) **Social Problems:** The advancement in modern science and technology has led to the decay in most of the urban centres of the world. Most of these urban centres are now being faced with the problem of environmental degradation as a result of concentration of industries from where emissions such as smoke and other harmful gasses are emitted into the atmosphere thus affecting global warming, (green house effect). Other problems include, sewage disposal problem, human congestion, traffic congestion, among others.
- (ii) **Ecological Problems:** The problems of preserving a healthy environmental balance, is one of the great problems caused by the advancement of science and technology. In a bid to make his environment better for living, man has exploited it as if it were an inexhaustible resource which has resulted into many hazards such as over-gazing, over-cultivation, soil erosion, flooding, pollution, desertification, drought, deforestation, global warming and so on.
- (iii) **Nuclear Warfare:** Globally the advancement in nuclear technology has brought about the anarchy of natural self-government especially between the two super power

blocs; each is committed to the defence of its own sovereign power. In fact, the availability of nuclear armory indeed has brought home the weaknesses of a world political system based on the independent nation status. For instance, the Iraq war where the United States of America and the allied forces defeated Saddam Hussein was as a result of nuclear warfare tussle. So also in Nigeria for instance, during ethno-religious riots, sophisticated weapons are employed as a result of advancement in science and technology.

ACTIVITY

1. Mention five positive effects of science and technology.
2. Highlight five limitations of science technology.

SUMMARY

- The impact of science and technology are noticeable in the following areas of mankind.
 - Large scale food production.
 - Preventive and curative medicine.
 - Power generation (electricity, fuel etc.).
 - Transportation.
 - Information technology.
 - Space exploration.
 - Military defence.
- Major problems created by science and technology include:
 - Population problem
 - Ecology problem
 - Nuclear warfare
 - Social problems.

ASSIGNMENT

1. Mention five effects of science and technology on man and his culture.
2. Highlights five (5) problems created by science and technology.

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- STAN (2001) **Fundamentals of Science and Technology – Society**. STAN Publications, Ibadan
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UNIT 3: TECHNOLOGY TRANSFER AND ADAPTATION IN NIGERIA.

INTRODUCTION

In most of the developing countries of the world, of which Nigeria is one, technological development is low. Most of these countries are mere consumers of the technological products, not producers. They have no experienced technological development. They do not even know where to start off. Most of them, Nigeria inclusive are in a state of confusion about the so called “technological transfer and adaptation”. That is, they are planning if possible to “take away” or “spy” or “borrow a leaf” from Japan, United States of America, Germany for their own technological development. These relative poor countries are now agitating for the technological transfer and adaptation to bring about changes in their countries.

What is technology transfer and adaptation? Can this be achieved in Nigeria? These questions are answered in this unit.

OBJECTIVES

At the end of this unit, you should be able to:

- (i) explain the concept of technological transfer and adaptation.
- (ii) discuss the technological transfers and adaptation in Nigeria.
- (iii) State the technological changes in Nigeria.

HOW TO STUDY THIS UNIT

1. Glance through the unit. Note the salient points as you read. Take note of the unfamiliar words and check for their meanings in your dictionary.
2. Now from the beginning, read and digest the unit thoroughly and systematically as arranged. Make sure you attempt all the activities stated. Before attempting the exercise, avoid looking at the answers provided.
3. Make sure the rules stated are strictly adhered to.

WORD STUDY

- Adaptation** - changing something to suit one’s needs.
- Dilemma** - in difficult condition.
- Hesitation** - worrying about doing something because you are not sure if it is right or wrong.
- Illusion** - a false belief or idea about something.
- Transfer** - move from one place to another.

TECHNOLOGY TRANSFER AND ADAPTATION IN NIGERIA.

Nigeria, one of the developing countries of the world is technologically backward. The issue of how her technology could be developed vis-à-vis her societal needs is now a serious problem. Therefore, one of the proposed strategies or approaches for the technological development in Nigeria is Transfer and Adaptation of Technology. This simply connotes the studying of the technologies of the technologically advanced countries such as Japan, Germany, United State of America, and adopting these to develop the country's technologies in line with the needs of the people. On the other hand, adaptation implies, the localization of the understudied aspects of technologies of those developed countries to suit the societal needs.

However, the advancement in technology of any country, and Nigeria is no exception, is based on factors, which can help the transfer and adaptation of technology to the country.

The factor include:

- (i) Social needs
- (ii) Social resources
- (iii) A sympathetic social ethos.

- (i) **Social Needs:** It mean what the society requires for its sustenance. The sense of social needs must be strongly felt in a society, otherwise, people will not be prepared to devote resources to a technological innovation or advancement. The need of a society may be for a more efficient cutting tool, a labour saving machine, a means of utilizing new fuels or new source of energy. Military needs may also be the requirement for better weapons and improved assault capability.

Furthermore, needs have been generated by advertising in modern societies. Therefore, whatever the source of the social needs, it is essential that enough people be conscious of it to provide a market for the commodity that can meet the needs of the people.

- (ii) **Social Resources:** In order to sustain any technological transfer and adaptation or innovation, a society has to be well primed with suitable resources. These social resources are indispensable pre-requisites to a successful innovation or transfer and adaptation of technology. These resources included skilled manpower, capital and materials.
 - (a) **Skilled manpower:** This implies the availability of technical skilled personnel capable of constructing new artifacts and devising novel processes.
 - (b) **Capital:** This involves the existence of surplus productivity and an organization capable of directing the available wealth into channels in which the inventor can use it.

- (c) **Materials:** This involves the availability of appropriate metallurgical, ceramic, plastic, oil, agricultural or textile substances that can perform whatever functions a new invention requires of them.
- (iii) **Sympathetic Social Ethos:** This means a society in which the dominant social groups are prepared to consider seriously the innovation or transfer of technology an adaptation. For instance, a community may be receptive of borehole water in place of the natural stream or river while another may not. Hence, there would be a need for the existence of socially important individuals in the second group who will be willing to encourage the investors and also to use their ideas and influence to persuade their people on the need for the borehole water. Therefore, such people are regarded as the sympathetic social ethos.

In any technology transfer and adaptation or technological innovation, the afore-discussed factors are “sine qua non” to be considered for any meaningful technological development to come by.

However, for any meaningful technology transfer and adaptation to take place, the following steps should be taken.

1. Identification of technologies that promote export-led industrialization.
2. Setting up a framework for deliberation on transfer of technology.
3. Improving collaboration in technology transfer.
4. Creating a mechanism for monitoring inflows of new and emerging technologies.
5. Establishing a science and technical intelligence unit.
6. Creating a data-base for technological intelligence unit.
7. Reviewing the current intellectual property – rights, laws and patent laws to safeguard inventions.

In conclusion, technology transfer and adaptation in Nigeria is manifested in the following areas through at a very low pace.

1. Fuel production Technology
2. Petro-chemical Technology
3. Construction Technology (road and building)
4. Agro-allied Technology
5. Information Technology – (the use of computer and mobile phone)
6. Biotechnology (forestry, Animal husbandry)
7. Medical Technology

8. Educational Technology etc.

SCIENCE AND TECHNOLOGICAL CHANGE IN NIGERIA

Though, with the low pace of technological development in Nigeria, changes in science and technology are noticeable in the following sectors of the society.

Food production: There is an appreciable increase rate in the production of food in Nigeria through science and technology in such areas like poultry, fishery, pastoralism, and crop cultivation.

Food specialists company such as Dangote group of companies is now producing rice, flour etc. for local and global consumptions.

Transportation: Means of transportation have been increased tremendously in terms of land, air and water transportation. In fact, road transport in Nigeria has provided flexible and door-to-door services for the people with considerable comfortability. Different vehicles – cars, trucks, motorcycles, bicycles are now being used on the Nigerian roads through changes in science and technology.

Communication: Changes have been so pronounced in this area in Nigeria, in recent times most especially in terms of information technology through the use of global mobile communication system, computer internet services, telephone, facsimile and so on. In fact, changes in technology in Nigeria and globally have turned the whole world to be a “global village”. That is, right inside ones room information can be received from any part of the world with the use of Global Mobile Communication System (GSM) and Computer Internet Services.

Education: The use of computer in Education is now in vogue in Nigeria. In fact, this has facilitated the teaching-learning process in the country. Computer is used for word processing, data analysis, entertainment, drawing of graphs, administrative purposes through Computer Managed Instruction (CMI) and instruction through Computer-Assisted Instruction (CAI) and so on.

Medicine: Infant mortality rate has been drastically reduced in Nigeria with the changes being brought by science and technology most especially through the use of medical technology in blood testing – Genotype. So also in other areas of medicine and para-medical areas such as nursing, pharmacy etc.

Fuel Production: Increase in the establishment of petro-chemical industries has been noticed in Nigeria through changes in science and technology e.g. Kaduna oil refinery, Warri. Port-Harcourt and other related petro-chemical industries in the country.

Construction: In the building, road and other forms of construction, changes being brought by science and technology have been remarkable with the modern architectural design, the use of modern materials such as marble, terrazzo etc. which have also contributed tremendously to the aesthetic appreciation of the environment in Nigeria.

By and large, the above-discussed changes are some of the major changes noticeable through science and technology in Nigeria.

ACTIVITY

1. Explain the concept of technology transfer and adaptation.
2. Mention five (5) changes in Nigeria through science and technology.

SUMMARY

- Technology transfer and adaptation mean the removal of the technology from other countries that are technologically advanced for implementation in line with the societal needs of the country concerned.
- Factors to be considered for meaningful transfer and adaptation of technology.
 - Societal needs.
 - Material resources.
 - Sympathetic social ethos.
- Changes in Science and Technology in Nigeria are remarkable in the following areas:
 - Food Production.
 - Communication.
 - Education.
 - Medicine.
 - Fuel Production.
 - Construction
 - Teaching

ASSIGNMENT

1. Differentiate between technology transfer and technology integration.

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