Introduction

By nature, man's supremacy over other living creatures is due to his ability to exploit and understand certain realities of the world. The fact that man is knowledgeable enough to know that he knows, triggers him to continue to quest for more knowledge. In the quest for the unknown, man has developed methods, ways and strategies to answer questions about his nature and the environment. One of the most plausible methods applied is through the process of research to understand the unknown and search for a solution.

Fundamentals of Research Methodology:

A holistic Guide for Research Organization, Management, Validation and Ethics

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Fundamentals of Research Methodology:

A holistic Guide for Research Completion, Management, Validation and Ethics

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Foreword

Research is a vast interdisciplinary undertaking which requires a conglomerate of thoughts and ideas to effectively comprehend its processes. In our present age, research cannot be avoided by anyone for it is the bedrock of our sustenance on earth. The understanding of its processes and how it is conducted is the interest of all, especially those in the academics and those who undertake research as a career. With this frame work in mind, the desire for a source document on research methodology for my students has been my ultimate quest.

This resounding collection of ideas is a piece of work enriched with knowledge suitable for beginners and experts to provide them with the "meat" of any research undertaking. This text is a comprehensive stepwise collection of ideas from various perspectives in academics to accompany a researcher throughout his research endeavour. It provides both practical and managerial knowledge for a successful completion of a research and how it can be communicated.

In the content, the author collated different aspects of research in terms of processes, resources, planning, management, validity and ethics which if not to my knowing is among a few source documents to have a cocktail of materials and information with practical examples to ease the understanding and comprehension of research. I therefore, recommend this piece of work to those actively and passively involved in research and most especially, to students at tertiary education to serve as a baseline guiding material for their academic and research career. It is my hope that the rich treasures contained in this collection be exposed to the academic society to bridge the research gaps between Africa and the Western society.

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The Nature of Research, Types and Studies

Introduction

By nature, man's supremacy over other living creatures is due to his ability to exploit and understand certain realities of the world. The fact that man is knowledgeable enough to know that he knows, triggers him to continue to quest for more knowledge. In the quest for the unknown, man has developed methods, ways and strategies to answer questions about his nature and the environment. One of the most plausible methods applied is through the process of research to understand the unknown and search for a solution.

Research is one of the most fruitful means of acquiring knowledge to widen our understanding of the society, foster development and manage problems. Through research, civilization was born and today the outcomes are enjoyed by everyone in the society. Thanks to research, man has been able to identify the cause and cure of certain diseases which are constantly a threat to humanity. Basic necessities are readily made available to us due to the emergence of industries in various sectors of the society. The applications of research have had great impact in fostering development and the economic viability of most nations today. Without research, the world will seem to be at a standstill. It becomes critical to clearly understand what research is and how it is employed to develop new ideas which will be useful for the development of our society and improve on man's well being.

Thus, this chapter gives a background on the basic knowledge of research alongside its importance to our contemporary society.

In fundamental concepts in terms of the nature, properties, approaches and categories of research will be explained. Furthermore, it will elaborate on the different types of researches and studies that are commonly conducted and their implications in the society.

What is Research?

A single definition may not be sufficient to explain what research actually is because it is very broad and involves almost all aspects of man's involvement on earth. However, if we carefully try to take a deep look into the processes involved, we will definitely notice that almost all research is systematic in nature from the beginning to the end. Hence, research can simply be defined as;

The process of arriving at dependable solutions to problems through a planned and systematic collection, analysis, and interpretation of data

One of the main purposes of research is to discover or develop answers to questions through the application of scientific procedures. As such, the main aim of research is to find out the truth of the unknown which is hidden and has not yet been discovered. Thus, it becomes an important tool for advancing knowledge, promoting progress, and enabling man to relate more efficiently with his environment.

Though each research study has its own specific purpose, generally, the purpose of a research may fall into any of the following broad groupings:

- To have a new insight or gain familiarity with a phenomenon,
- To accurately describe the characteristics of a particular individual, a group, situation or event,
- To determine the frequency at which something occurred either in the past, present or future
- To find out how something is associated with another or an event

- To test a hypothesis for a causal relationship between the variables.

Reasons for Research

A question which is rarely addressed, but very necessary to justify your interest in research is that of the motivation for undertaking it. There are a lot of reasons why people do carry out research, but a few of these reasons are common for most researches and researchers. It is either one's desire to;

- Obtain a research degree for his career,
- Solve unsolved problems,
- Be creative and make new discoveries,
- Be of service to the society,
- Be respected and honoured,

However, this is not an exhaustive list of factors motivating people to undertake a research. Many more factors such as governmental position, new things, employment conditions, social thinking, curiosity or desire to understand the cause of an event etc. may as well motivate or compel people to get involved in research.

Importance of Research

Research is one of the aspects in academics with a very broad scope of applications whose importance cannot be quantified. The importance of research cannot be over emphasized as the benefits are observed on a daily basis. However, though vast, it can be summarized into the following four major categories; academic progress, discovery, problem solving and development.

Academic Process

Progress in almost every field of study depends on the contributions made by systematic research. Thus, research is often viewed as the cornerstone of academic progress and the gateway for the development of various academic disciplines. The fact that man always wants to advance his knowledge at the tertiary level of

education whereby academic advancement are usually based on research, has exposed man to new thoughts, theories and specialties. As such, so many new fields have been carved out from the general or parent fields of study to become more specialized ones thereby addressing specific issues of the society. In science, so many new fields such as Genetic Engineering, Biotechnology, Bioinformatics, Information Technology, etc. have emerged from the mother academic fields which include biology, chemistry, physics, mathematics, etc. For example, the discovery of DNA and development of recombinant DNA molecules through research led to the development of genetic Engineering as a new field of study which emerged from Biology. A few examples of such new emerging fields of study through research can be summarized in the table below.

<table>
<tr><td></td><td colspan="4">General Academic Field</td></tr>
<tr><td rowspan="2">Basic concept</td><td>Biology,</td><td>Chemistry</td><td>Physics</td><td>Geology</td></tr>
<tr><td colspan="4">Mathematics</td></tr>
<tr><td>Application</td><td colspan="4">Specialised Academic Field</td></tr>
<tr><td rowspan="2">Material science</td><td colspan="2">Molecular biology/ Biochemistry</td><td colspan="2">Geophysics</td></tr>
<tr><td>Biotechnology / Genetic engineering</td><td>Chemical Engineering

Industrial Chemistry</td><td>Nanotechnology

Electrical Engineering</td><td>Petrochemical Engineering</td></tr>
<tr><td>Information science</td><td>Bioinformatics</td><td>Chemioinformatics</td><td colspan="2">Information Technology</td></tr>
</table>

Figure 1: Academic Progress in Science through Research

Discovery

Every single day on earth is marked by at least one new discovery which could either be a new organism, material, principle, law, technology, discipline, or theory, etc. Some of these new discoveries which have practical applications are aimed to improve on our knowledge about certain realities of the universe that are beneficial to man. Some can help in fostering our understanding of nature how certain processes occur with their underlining causes and consequences to the society.

Problem solving

Research has a paramount role of providing solution to various problems and always had a baseline function to provide answers to problems. Thus, it is a means to our problems in the society. Research problems are very broad and diversified, but physical observed problems are usually those that have direct impact to the society. Health problems, technological challenges, socioeconomic problems are a few of those areas in which research has enormously contributed in seeking solutions. Through research, the origin, causes of some diseases have been discovered. Also, further research has made possible the treatment of some diseases as well as other methods of disease management such as vaccination.

Development

Research and development are two processes that are inseparable. Research serves as the backbone of development in our society through which goods and services can be provided. To achieve development through sciences, ideas in research need to be practically translated by technology to goods and services to have real life applications. This usually requires new ideas, particularly from specialized disciplines which can be exploited to develop new technologies with practical applications in the society. In a nutshell, the overall outcome of research is to provide goods or services to the society which will eventually foster development and satisfy our desire.

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Relationship between Science, Research, Technology and Development

When one thinks of development, it is obvious the terms science, research and technology cannot be set apart. Sometimes, the terms, science, research and technology are interchangeably used to describe certain activities simply because they are interdependent on each other. To clearly understand the relationship between science, research, technology and development, one needs to define them individually and link them up to understand their relationship.

Science from Latin *scientia*, meaning "knowledge" is a field that systematically builds and organizes knowledge in the form of testable explanations and predictions about the universe. In an older and closely related meaning, "science" also refers to a body of knowledge that can be rationally explained and reliably applied. Two aspects of sciences that are fundamental to its definition is the ability of a concept to be tested and provide result using a scientific method.

The scientific method is the basis of empirical research which is systematic in nature to provide answers to dependable problems. The outcome of research could be such that no application is attributed but may apply to the basic underlining concepts of the field of study. On the other hand, some scientific studies or research may produce results which have an immediate application in real life. This application is that which drives us to the term technology.

Technology is mostly described as an applied science which can be organised to have practical implications in life. However, because technology must satisfy societal requirements and values such as utility, usability and safety, technology cannot be considered as an exclusive product of science. Most technologies in the past were discovered without a scientific background. One of such was the production of fire or heat energy from the sparks of stones without any scientific dependence. Also, the invention of stone weapons for wars and stone axes as agricultural tools were the technologies within the Paleolithic era when the basic concepts of sciences were

not yet laid. Today, because of the advancement of science, almost all recent technologies have a scientific background. When a new technology is discovered, it needs to be made available to the society. This process of providing a technology or its product to the masses is what is known as engineering. Engineering is therefore the goal-oriented process of designing and making tools and systems to exploit natural phenomena for practical human means, often (but not always) using results and techniques from science.

The fundamental objective of developing a technology is to provide good or services that will meet the demands or improve on the needs of the society, hence ensuring development. This implies that for development to be achieved there must be some inputs which will have a positive impact or changes to improve on the well being of man. Some of such inputs are applied sciences and technology. Thus science, research, technology and development are symbiotic in their relationship as they are interdependent on each other. This relationship can be seen in the figure below.

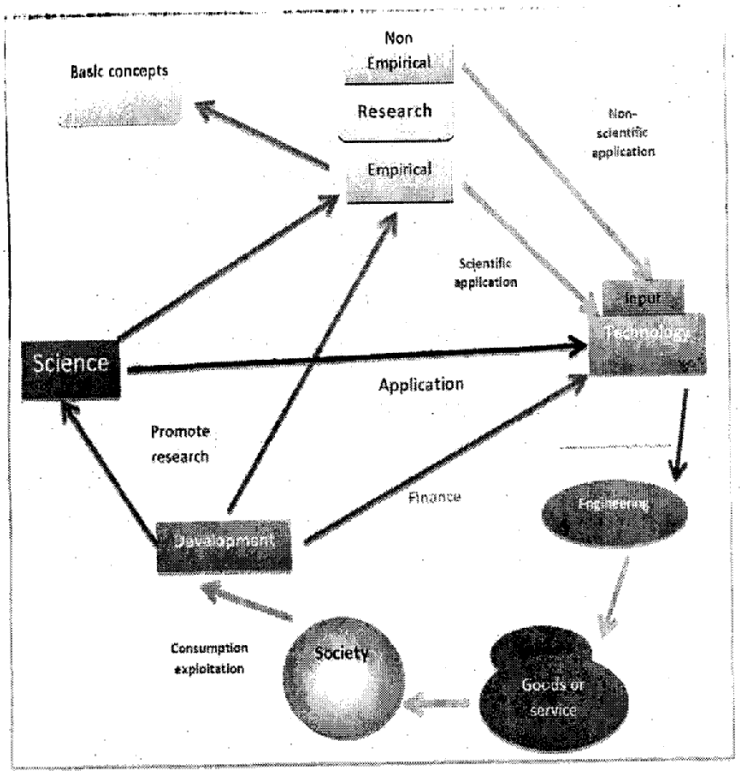

Figure 2: Relationship between Science, Research, Technology and Development

Research Methodology and Importance

The study of research methodology gives us the necessary training on how to conduct field work, gather and arrange data. It also provides training on the techniques of collecting appropriate data to particular problems through the use of statistics, questionnaires and controlled experimentation and in recording evidence, sorting it out, interpreting and reporting data.

[redacted]nding research methodology and its techniques is important for someone who is preparing himself for a career in research since it constitute the tools of his trade. The knowledge of research methodology will provide good training especially to a new research worker and enables him to do better research. It helps him to develop a focus thinking or a 'bent of mind' to observe the field objectively. Hence, research methodology is an important tool for those aspiring for a research career and thus necessary to develop the skill of using the techniques and know the logic behind them.

Knowledge of research methodology will inculcate into individuals, the ability to evaluate and use research results for various applications in life. Thus, the knowledge of research methodology is helpful in various fields or sectors such as government, business, administrative job, community development and social work whose job description necessitates research evaluation.

Understanding the nature is usually not so easy if one is not objective in his approach. To achieve this, one may have to acquire an intellectual tool which is systematic in its approach of investigation and making useful judgments. Thus, knowledge of research methodology will enable us to make intelligent decisions concerning natural problems facing us in practical life at different points of time. In other words, the knowledge of research methodology provides tools to look at things in life objectively.

Nature of Research

Naturally, research can take different forms based on the type of underlining characteristics of the problem that is to be addressed. The nature a research may assume can depend on the purpose of the research, type of observational unit being addressed, time of assessment, etc. Base on the above factors, research can exist in various categories, groups or types.

Fundamental / Applied Research

Fundamental Research

Fundamental, basic or pure research is a research directed towards understanding nature and the discovery of new area or field of investigation without a practical connotation in mind. Its overall objective is to expand knowledge of natural phenomenon and have an understanding of the physical and chemical constituents of living and non-living processes alongside their functional mechanisms.

Pure research involves developing and testing theories and hypotheses that are intellectually challenging for the researcher, but may not have an immediate practical application. The knowledge produced through pure research, usually adds to the existing knowledge of that research area and usually serves as a building block on which applied research is based. They also serve as the platform for the creation of almost all theories, principles and laws which are applicable in life with regards to the various fields of study. Examples of fundamental research include; research in understanding the constituents of a cell, matter, mechanisms or functioning of living processes.

Applied Research

This is a research which is geared towards a specific practical objective to serve man's need. Mostly, this research depends on the aspects, concepts, theories, etc. of basic research to develop practical applications in the society. Applied research can be undertaken to solve specific practical questions, formulate laws or policies, provide goods or services to the public, explain phenomena or foster development through new technologies. It is usually descriptive, but can also be exploratory in nature . It is mostly carried out on the basis of basic or fundamental research. Applied research can be carried out by either academic or industrial institutions. In the case of an academic institution such as a university, specific applied research program is usually funded by an industrial partner who is interested in its application. Thus, applied research serves as the basis of technology and development in the world as it applies to

various fields with numerous applications in the industrial, health, agricultural, infrastructural and other sectors in the society.

Outcome of Research in Terms of Basic Concept and Application

The outcomes of a research can either be an immediate application to the society or the basic concepts of the field which may not have an immediate application but contribute to develop new theories, principles or laws. Based on these outcomes, research can be grouped into four categories;

- **Category I:** Research that does not apply to the basic concept and does not have an application
- **Category II:** Research that applies to the basic concept, but does not have an application
- **Category III:** Research that does not apply to the basic concept, but has an application
- **Category IV:** Research that apply to the basic concept and has an application

Category I researches are usually a repetition of studies which do not have any particular question to address. Such research may lay the basis for routine mastery of techniques, principles or theories but do not greatly contribute to the development of a nation or community. They are usually called redundant research because they do not really lead to any new discovery since no new problem is being addressed.

Category II research is that which contributes to the basic concepts of that field or area of study even though applications may not be attributed. They may either support or disagree with some of the existing concepts or postulate new concepts or theories. For examples, the identification of certain components in the cell, or structure of molecules such as DNA, amino acids, proteins belong to this category of research.

Category III research, usually does not contribute to the basic concepts, but has a direct application. They do not usually have an explanation for the results obtained but rather have very useful

applications in the society. The researchers who discovered fluorescent light produced it just by passing current across electrodes but had no explanation to the phenomenon.

Category IV research is that which contributes or applies to the basic concepts and equally has an application. This is the most productive research because it greatly contributes to development. Newton's research led to the creation of the Newton's laws of motion which applied to the concepts of physics with direct application in the production of automobiles, aircraft, machines etc. Similarly, Louis Pasteur, the father of microbiology laid the concept of microbial growth and applied the concept of microbial culture in industries for the production of alcoholic beverages, yogurts and biopharmaceuticals such as antibiotics, vaccines etc.

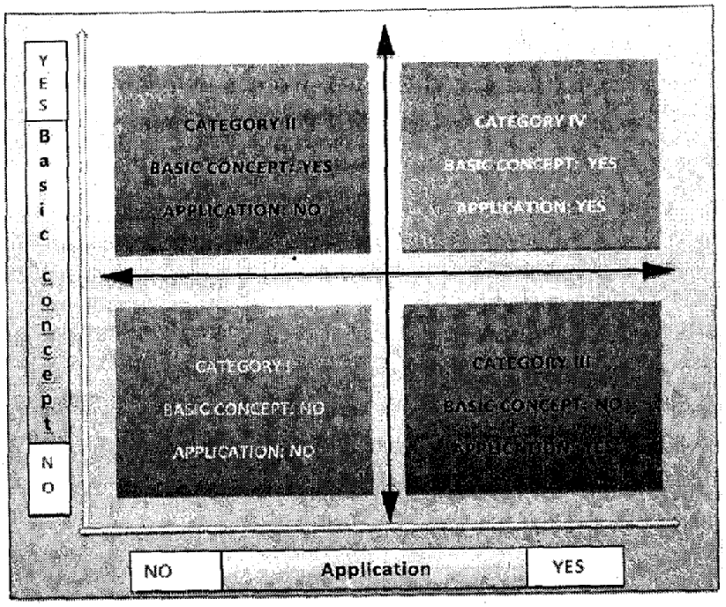

Figure 3: Categories of Research

Deductive / Inductive Research

Deductive Approach

Deductive research moves from general ideas/theories to specific situations; that is, a particular idea/ theory is deduced from a

[redacted]pect e.g. broad theories. In such research, the objective is [redacted]ave a clear theoretical position before data collection which can be used to address a specific question or problem. If you want to test a theory on a particular set of people, for example, fat people die of cardiovascular disease (general theory), you could carefully select a sample of people on the basis of age, gender, occupation etc. for the study and collect data using a questionnaire, structured interviews or group discussion. The data gathered could then be collated and the results analysed and presented to describe that theory with respect to that particular group. This approach offers researchers a relatively easy and systematic way of testing established ideas on a range of people. The majority of our researches is deductive in nature and easy since we have a focal point to begin from.

Inductive Approach

Inductive research is that which moves from particular or specific situations to infer to broad ideas/theories. If you adopt this approach, you can start by talking to a range of people asking for their ideas on fat and cardiovascular disease. From their result, you could start to assemble the common elements and compare them. The analysis can draw to a conclusion which can be generalized to the public and becomes a theory if it is tested in different places and the same result is obtained. This approach of research is mostly applied by sound researchers and usually leads to the discovery of new ideas, theories, laws, etc. However, this approach is difficult, time-consuming and entails a lot of work.

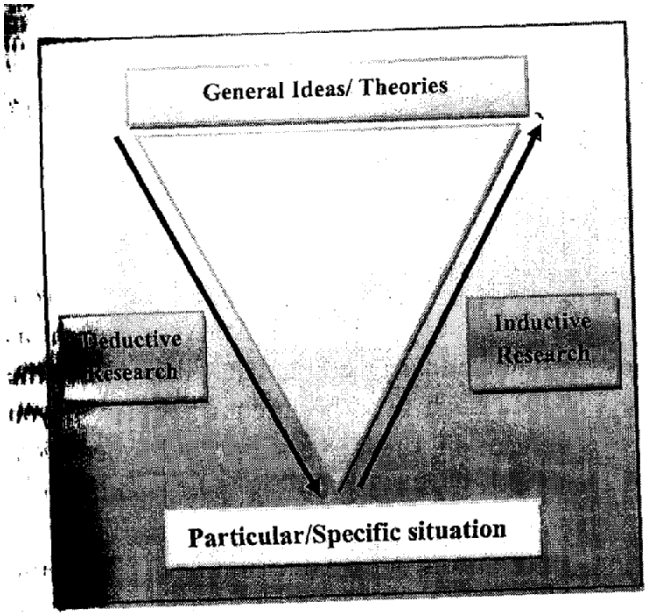

Figure 4: Deductive/Inductive Research Approaches

Empirical / Non-Empirical approach

Empirical Approach

The empirical approach is evidence or fact based. It relies on direct observation and experimentation for data collection to acquire new knowledge. In this approach, scientific decisions are made based on data derived from direct observation and experimentation. The empirical approach, with its emphasis on direct, systematic, and careful observation, is best thought of as the guiding principle behind all research conducted in accordance with the scientific method. Hence, it is the approach employed in scientific research and exploited by most scientific fields.

Non-Empirical Approach

In non-empirical approach of research, the decision making is non-scientific without facts which are based on direct observation. However, most of the decisions made are based on feelings, intuition, personal thought without any scientific judgement. Additionally, they may often reach conclusions or make decisions that are not

necessarily based on data, but rather on opinions, speculation, o
future hopes.

Quantitative, Qualitative and Mixed Research

Quantitative Research

Quantitative research is that which generates statistical results fro
large-scale surveys for data collection using methods such a
structured interviews or questionnaires or studies which involve th
collection of numerical data such as experimental studies. If yo
have ever been interviewed on the streets or have filled in
questionnaire, then, have in mind that you are participating in
quantitative research study. This type of research has the tendenc
to involve the public since more people are implicated and th
contact with those people is much quicker than it is in qualitativ
research. The basic building blocks of quantitative research ar
variables.

Variables are things that take on different values or categories an
are the opposite of constants (something that cannot vary, such as
single value or unit).

These measurements can either be categorical (qualitative) an
quantitative. For example, quantitative variables vary in degree o
amount (e.g., annual income) and categorical variables vary in typ
or kind (e.g., gender, grade). The measurement could also be a
independent variable (IV) which is the presumed cause of an effe
and a dependent variable (DV) which is the effect or outcome of th
independent variable. Dependent variables can be influenced by on
or more independent variables.

Sometimes, certain variables may influence others by interferi
them. Such variables are called intervening variables (also called
mediator or mediating variables). Intervening variables a
variables that occur between two or more other variables. F
example, tissue damage is an intervening variable that interfere th
relationship between smoking and lung cancer. We can use arrov

ct an example of a relationship in which an intervening le participates; Smoking → Tissue Damage → Lung Cancer, re tissue damage is an intervening variable.

Sometimes, certain relationships between variables do not generalize to everyone, but the presence of an additional variable may be used to express the level of variation between them. Such which can be used as a measure to describe the level of n between variables are called moderator variables. For e, perhaps behavioural therapy works better for males than les while cognitive therapy works better for females than in . In this case, gender is the moderator variable since the onship between the type of therapy (behavioural versus cognitive) and psychological relief is moderated by gender. The r types of quantitative research are experimental and non-erimental research.

Experimental Research

The purpose of experimental research is to study the causal-effect relationship. The defining characteristic of this research is the active manipulation of an independent variable (i.e., it is only in experimental research that "manipulation" occurs). Also, random assignment (which creates "equivalent" groups) is exploited for ping in this research. Experimental design is mostly used in ing new treatments. For example, an experiment to test a new ent against tuberculosis will require grouping the participants experimental and control group in which the effect will be red before (pretest) and after (posttest) treatment.

	Treatment	Posttest
p	$A_T B_N$	$A_E B_O$

rimental group, B=Control group, O= No effect, E= Effect, T nt N =No treatment

the two groups similar in the above research design, we domly assign the participants to the experimental and

control groups. Assuming we have a convenience sample of 100 people, we shall randomly assign 50 to each group (A and B). After making the groups, approximately the same at the start of the study by random assignment (i.e., the groups are "equated"), the participants will be pretested for the effect. Then, after manipulation of the independent variable by using a new treatment for the experimental group and an old treatment for the control group, the effect of the treatment will be measured in both groups. Let's say that the people in the experimental group were treated against tuberculosis than those in the control group, we can conclude that there is a causal relationship between the independent variable (new treatment) and the dependent variable (tuberculosis). More specifically, it can be said that the new treatment is better than the old one in treating tuberculosis.

Non-Experimental Research

In non-experimental research, there is no manipulation of the independent variable or no control as well as no random assignment of participants to groups. As such, there will be no cause-effect relationship between two variables in a non-experimental research. We can distinguish between two examples of non-experimental research; the causal-comparative and correlation research.

Causal-comparative research involves a relationship between one categorical independent variable and one quantitative dependent variable without manipulation and random assignment. For example, a study to evaluate the class performance (dependent variable) base on gender (independent variable). In this example, you would look for the relationship by comparing the male and female average performance levels.

Correlational research is that which involves a relationship between one quantitative independent variable and one quantitative dependent variable. For example, a relationship between the independent variable self-esteem and the independent variable class performance. In such a research which involves both variables as quantitative, the relationship will be obtained by calculating th

[redacted]ction coefficient. The correlation coefficient is a function used [redacted]press the degree of relationship between variables. It is [redacted]pressed numerically and varies between -1 (weak relationship) and +1 (strong relationship) with 0 indicating no relationship. The further the number is away from 0, the stronger the relationship. If the sign of the correlation coefficient is positive (e.g., +.50) then you have a positive correlation, which means the two variables move in the same direction (that is, as one variable increases, so does the [redacted] variable or vice versa). Education level and annual income [redacted] have a positive correlation if high annual income is related to [redacted]evel of education. If the sign of the correlation coefficient is [redacted]ve (e.g., -.35) then, you have a negative correlation which [redacted]ans the two variables move in opposite directions (as one [redacted]iable increases, the other decreases or vice versa). Smoking and [redacted]pectancy are negatively correlated (i.e., the higher the [redacted]oking, the lower the life expectancy).

Qualitative Research

Qualitative research is a type of research that evaluates qualitative variables such as behaviour, attitudes and experiences through methods such as interview or focus group. It attempts to get an in-depth opinion of the participants to evaluate certain qualitative values. In this research, fewer people take part in the research, but the contact with these people tend to last a lot longer than in quantitative research. There are five major types of qualitative research. This includes; phenomenology, ethnography, case study research, grounded theory, and historical research.

Phenomenology: This is a form of qualitative research in which the researcher attempts to understand how a phenomenon is being experienced by one or more individuals. For example, one may interview 50 widows to know their experiences during the period of [redacted] deaths of their husbands.

[redacted]nography: Is a qualitative research that describes the culture of [redacted] group of people or an ethnic group. An example of ethnographic

study may entail a researcher to go and live in a community to study the culture and educational practices.

Case study research: This type of qualitative research provides a detail account of one or more cases in the society. For example, one may study the growth of a company for a defined period of time.

Grounded theory: Is a qualitative research approach in which data collected from a researcher are used to generate and develop a theory. For example, data may be collected from a community, environment or region to explain how and why a phenomenon occurs.

Historical research: Research about events that occurred in the past clearly describes this category. A study of the culture of an ethnic group in the 18th century is a good example of such research.

All of these approaches are similar in that they are qualitative in nature. However, each approach has some distinct characteristics and tends to have its own roots and following.

Mixed Research

This type of research involves quantitative and qualitative methods combined together to describe problems from both concepts. Mixed research is a general type of research in which quantitative and qualitative methods, or other paradigm characteristics are mixed together in one overall study. Most researches which are aimed at addressing social issues of the society usually utilize a mix research approach. The two major types of mixed research are the mixed method and mixed model.

Mixed Method Research: This is a research in which the researcher uses the qualitative research paradigm for one phase of the study and the quantitative research paradigm for another phase of the study. For example, a researcher might conduct an experiment (quantitative) and after which he conducts an interview study with the participants (qualitative) to see if their responses agree with the

experimental result. Mixed method research is like conducting two mini-studies within one overall research study.

Mixed Model Research: This involves a research in which the researcher mixes both qualitative and quantitative research approaches within a stage of the study or across two of the stages of the research process. For example, a researcher might conduct a survey and use a questionnaire which contains multiple closed-ended or quantitative type items as well as several open-ended or qualitative type items. Another example is that in which a researcher might collect qualitative data, but then try to quantify the data.

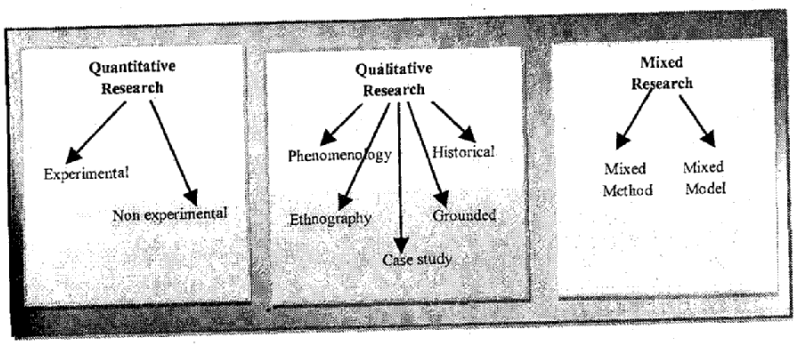

Figure 5: Quantitative, Qualitative and Mixed Research Tree

Research Categories

Based on the purpose of a study, research can be classified in various categories such as exploratory, descriptive, predictive, and causality.

Exploratory Research

Exploratory research is done when a few or no previous studies exist to explain a phenomenon, problem, or naturally occurring processes. The aim is to look for patterns, hypotheses or ideas that can be tested to form the basis for further research. Such research is usually done by case studies, observation and review of previous related studies. It is one of the most useful research methods employed in addressing phenomenon where there exist high levels of uncertainty and ignorance about the subject or when the problem is not very well understood, especially when very little existing

research has been done on the subject matter. As such, exploratory research is usually flexible without any formal structure to follow. Rather, the procedures are laid as the study progresses based on the findings obtained. Exploratory researches aim mainly to identify the boundaries of the environment in which problems or situations of interest are likely to reside and to identify the salient factors or variables that might be of relevance to the research.

The use of exploratory research for a new phenomenon might involve a literature search or conducting focus group interviews to help the researcher for better understanding, test the feasibility of a more extensive study, or determine the best methods to be used in a subsequent study. Due to the lack of a specific method of approach and the broadness of exploratory research, it rarely provides definite answers to specific research issues. Even though the answers may not be specific in exploratory research, the researcher must be able to identify the key issues and variables implicated in the research. Thus, calling your report "exploratory" is not an excuse for lack of definition.

Descriptive Research

As its name may suggest, descriptive research seeks to provide an accurate description of observations of a phenomenon. The objective of collecting data of census is to accurately describe basic information about a population at a particular point in time. A study of this type could start with questions such as: "What are the similarities or differences between A and B"? Where A and B are different departments in an organisation, different regional operations in a firm, or different states in a country. Such descriptive comparisons can produce useful insights and lead to hypothesis formation. Quantitative techniques are most often used to collect, analyse and summarize data in descriptive research and can be easily be presented in graphs and tables as whole numbers or in percentages. Descriptive research can be used to identify and classify the elements or characteristics of the subject. For example, the prevalence of malaria in various age groups of people in Nigeria.

[redacted] or Analytic Research

[redacted]l research is often an extension of descriptive research to [redacted]st or explain why or how something is happening. It simply [redacted] to identify the underlying causes of a phenomenon by analyzing the different factors (or variables) involved. For example, the cause of malaria in young children in Nigeria after a descriptive study has been attributed to the absence of malaria diagnostic tools. Causal research is very structured in nature and aims to identify any causal [redacted] between the factors or variables that pertain to the research [redacted]blem. The most usual of such research is experimental research [redacted]reby a treatment administered is compared with a control and [redacted] effect is monitored. For example, a study to determine the cause of lung cancer can simply be done in animals by comparing a hypothetical treatment group (let say animals expose to smoke or mutagen) with a control group without exposure. Both groups will be monitored together to observe the presence of lung cancer to confirm or reject the hypothesis. Here, the type of experimental design will be directed based on the question posed.

Laboratory based research also belongs to this category as experimentation can help to identify the cause of certain issues. Laboratory based research do not only determine the cause but will try to explain (exploratory) how it happens; usually described in science as the mechanism of action. Laboratory based research do not necessarily require defined groups, but rather make use of case hypothesis and analytic testing. This research can pave the way for predictive research in which mathematical models are used to define a problem to predict an event.

Predictive Research

The aim of predictive research is to speculate intelligently on future possibilities, based on close analysis of available evidence of the cause of an effect. For examples, predicting when and where future [redacted]dustrial action might take place, predicting the likely population of [redacted] world by 2050 etc. Predictive research usually makes use of [redacted]thematical models which can be used to propose a possible state [redacted]he future or a situation. In this research, experimentation is not

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usually frequent but laboratory based research may be possible. One of the critical factors usually monitored is the rate of change of an event or effect which can be used as a guide or pattern to predict the future or a situation.

Table 1: Research Categories with the Types of Questions Addressed and Examples

Research Categories	Question	Examples
Exploratory	What is the case? What are the key factors?	What are the critical success factors of a developed nation? What are the distinguishing features of a good leader? What are the reasons for poor health care service in Nigeria?
Descriptive	How many? What is the incidence of x? Are x and y related?	How many students are there in Godfrey Okoye University? What is the incidence of Cholera in Nigeria today? Is there a correlation between parental support and scholastic achievement?
Causal	Why? What are the causes of y?	Why is malaria a major problem in children? Is smoking the main cause of lung cancer?
Predictive	What will the effect of x be on y? What will be the effect in the future?	What effect will the introduction of a new antibiotic have on the population P? What will be the world's population in the year 2050?

Types of Research Studies

Quantitative Studies

Surveys

Surveys are studies designed to set forth facts and observations without seeking the causes and/or any interrelationship among the variables. They are usually descriptive in nature to present a situation at defined period of time. Survey studies can either require the involvement of the whole population or just a sample of the population.

Census is usually survey in which the entire population is involved in the study. For example, to determine the population of Nigeria will involve the counting of every single person in Nigeria. A census on workers of the public service will involve all the workers who directly work for the service of the government.

The other category of survey involves the selection of a representative and unbiased sample of subjects drawn from the population to be studied. The main methods of asking questions are by face-to-face or telephone interviews, by using questionnaires or a mixture of the two.

Cross-sectional Studies

This is a type of study involving samples of different sub-groups of a population to look at similarities or differences between them at any particular time. This study involves a close analysis of a situation at one particular point in time to give a 'snapshot' result. Cross-sectional studies are done when time or resources for more extended research are limited. Sometimes, certain research questions may want to address problems at a particular point in time. During an outbreak of a disease, such questions are being addressed to determine the incidence. For example, a study on the incidence of ebola virus disease in different age groups of people in Liberia.

Longitudinal Studies

Sometimes, to clearly understand the cause or evolution of a problem, it is necessary to monitor the effect or outcome of the problem with time. Longitudinal studies will answer such questions. These are studies over an extended period to observe the effect that time has on the situation under observation and to collect primary data (data collected at first hand) of these changes. Research carried out longitudinally involves data collection at multiple points in time.

Longitudinal studies can often be conducted over several years, which make them unsuitable for most relatively short post-graduate programmes. However, it is possible to make short time scale research on primary data collected in longitudinal studies.

In longitudinal studies, the same groups of people are enrolled in a study and are monitored or followed for a period of time. Data is collected on the same group of people at different point in time. The advantage of this study is that it makes use of the same sample to find out whether the different groups chosen are comparable thereby avoiding the assumptions made about in cross-sectional studies. A good example of a longitudinal study in public health could be a study to monitor the efficacy of coartem for the treatment of malaria in Nigeria from 2014 to 2015. Longitudinal studies may take different forms which include;

Trend study: This study looks at population characteristics over time, e.g. organizational absenteeism rates during the course of a year.

Panel study: In this study, the same sample is traced over time, e.g. graduate career tracks over the period 2000-2010 for the same starting cohort.

Cohort study: It traces sub-populations or groups over time. Based on time, cohort studies can either be prospective or retrospective in nature.

Prospective studies involve recruiting participants, then following them to count events of interest over a defined period of time. The particularity in prospective studies is that fresh data is collected as time changes to new or future time. A good example includes a study to monitor the efficacy of coartem against malaria from January to March, 2014.

In retrospective studies, this is not the case. Instead of fresh data being collected, existing data that were previously collected for a period of time is traced back and obtained for analysis. Data is usually collected from past record or archive for retrospective studies. Because of the greater control over how data are collected, prospective studies are considered to be more accurate than retrospective studies. However, prospective studies can take a longer time to conduct than retrospective studies and hence, more expensive than retrospective studies. Also, there is a greater chance of participant loss during the course of follow up or drop out over time in prospective studies. While longitudinal studies will often be more time consuming and expensive than cross-sectional studies, they are both more likely to identify causal relationships between variables.

Correlational Studies

Correlational research comprises of collecting data to determine whether, and to what extent, a relationship exists between two or more quantifiable variables. Hence, it is descriptive in nature. The degree of relationship is expressed in terms of a coefficient of correlation. If a relationship exists between variables, it implies that one variable is associated with or varies with another. The exploration of the relationship between variables provides insight into the nature of the variables themselves as well as an understanding of their relationships. If the relationships are substantial and consistent, they enable a researcher to make predictions about the variables.

Correlational research aims to determine the nature, degree and direction of relationships between variables or using these relationships to make predictions. Correlational studies typically

investigate a number of variables to find out whether they are related to a major, complex variable. Those variables which are not found to be related to this major, complex variable are excluded from further analysis. On the other hand, those variables which are found to be related to this major or complex variable are further analysed in a causal-comparative or experimental study so as to determine the exact nature of the relationship between them.

Correlational study does not specify cause-and-effect relationships between variables under consideration. Rather, it merely specifies concomitant variations or relationships in the scores on the variables which are just descriptive. For example, there is a strong relationship between students' scores on academic achievement in mathematics and their scores on academic achievement in science. This does not suggest that one of these variables is the cause of the effect of the other because a third variable such as students' intelligence could be the cause of student's academic achievement in both, Mathematics and Science.

Experimental Studies

They seek to determine if a specific treatment influences an outcome of a situation. This can be assessed by providing a specific treatment to one group, but withholding it from another and then, the outcome or effect will be compared for both groups. Experiments include randomised experiments, with the random assignment of subjects to treatment conditions, and quasi-experiments that make use of non-randomised designs. Experimental studies are carefully done in controlled and structured environments to enable the causal relationships of phenomena to be identified and analysed. The variables can be manipulated or controlled to observe the effects on the subjects studied. For example, to monitor the efficacy of a new drug, individuals can be grouped into two; one experimental group which receives the new treatment and one control group which receives the existing treatment or no treatment at all. The two groups will be monitored to observe whether any differences exist on the outcome of the treatment between the groups.

Studies done in laboratories tend to offer the best opportunities for controlling the variables in a rigorous way, although field studies can be done in a more 'real world' environment. However, with the former, the artificiality of the situation can affect the responses of the people studied, and with the latter, the researcher has less control over the variables affecting the situation under observation. For examples, a laboratory based research on animal models to test the efficacy and safety of drugs can easily be controlled, but this may not reflect the same outcome when conducted in humans.

Case-Control Studies

Case-control studies involve comparing a group of people (referred to as 'case') with a condition or disease with a healthy group from a similar population (referred to as 'control'). The two groups may be asked to recall past information and/or their medical records may be examined. This study aims to determine the importance of suspected causal agent or to examine possible outcomes. Adjustments are made to allow for other factors such as confounding factors that may also have contributed to the development of the disease or condition. Case-control studies can be helpful when investigating a condition that is rare.

Qualitative Studies

Historical Studies

Historical research deals with the determination, evaluation and explanation of past events to have better and clearer understanding of the present and make more reliable predictions of the future. Unlike researches in the natural science which are based on experimentation, historical research depends on documents from which evaluation is made for evidence accruing from physical, relics, or written records to establish facts or generalizations regarding past events.

It is the oldest form or method of collecting data developed by Greek historians. Historical sources are classified in terms of physical objects (or relics) and of written or printed documents. The

researcher's task is to formulate hypothesis and examine his da the form of documents (written) or relics (archaeologica geological remains such as tools and utensils).

In addition, the sources of data may be primary and/or secon Primary sources of data are data provided by actual witnesses to incidents in question. Secondary sources of data are usu provided by writers who acted as middlemen between the orig witnesses and the present consumers.

Documentary Studies

Documentary analysis is closely related to historical research si in such research, we study existing documents. But the m difference is that historical research lays emphasis on the study the past while for documentary research the emphasis of the study the present.

Documentary analysis could be defined as a research technique f the objective, systematic, and quantitative description of th manifest content of communications. Documentary analysis today a widely used research tool aimed to determine the presence certain words or concepts within texts or sets of texts. It is technique for making inferences by objectively and systematicall identifying specified characteristics of messages. The method o documentary analysis enables the researcher to include larg amounts of textual information and systematically identify its properties. Researchers quantify and analyse the presence meanings and relationships of such words and concepts to make inferences about the messages within the texts, the writer(s), the audience and even the culture and time of which these are a part.

Documentary analysis is not restricted to the domain of textual analysis, but may be applied to other areas such as coding student drawings or coding of actions observed in videotaped studies, analyzing past documents such as memos, minutes of the meetings, legal and policy statements etc. The technique can only be applied to data that are durable in nature in order to allow for replication. Texts for documentary analysis can be obtained from books,

discussions, interviews, newspaper headlines, articles, historical documents, speeches, conversations, advertising, theatre, informal conversation, or any document for communication.

Documentary analysis enables researchers to sift through large amounts of data with comparative ease in a systematic manner. It can be a useful technique for allowing one to discover and describe the focus of individual, group, institutional or social group. Most documentary analysis research is motivated by the search for techniques to infer from symbolic data what would be too costly, no longer possible, or too obtrusive by the use of other techniques.

Ethnography Studies

Ethnographic studies are usually holistic, founded on the idea of culture that human beings are best understood in their environment of origin. This will include the place where they live, their improvements and contributions in that location, how they make a living, that is; food, housing, energy and water for themselves, what their marriage customs are, what language(s) they speak and so on. Ethnography is a form of research that focuses on the sociology of meaning through close field observation of socio-cultural phenomena in a community. Ethnography is essentially a branch of social and cultural anthropology that may be approached from the point of view of art and cultural preservation and as a descriptive rather than analytic endeavour. The method starts with selection of a culture, review of the literature pertaining to the culture, and identification of variables of interest, that is variables perceived as significant by members of that culture.

Ethnography is an enormously wide area with an immense diversity of practitioners and methods. However, the most common ethnographic approach is participant observation and unstructured interviewing as a part of field research. The ethnographer becomes immersed in the culture as an active participant and record extensive field notes. In an ethnographic study, there is no preset limit of what will be observed and interviewed and no real end point In as is the case with grounded theory.

Case Study

Case study research is a descriptive research that involves describing and interpreting events, conditions, circumstances or situations of a particular "case" that are occurring in the present. The case study method is a technique by which individual factor whether it be an institution or just an episode in the life of an individual or a group is analysed in its relationship to any other in the group. Its distinguishing characteristic is that each respondent (individual, family, classroom, institution, cultural group) is taken as a unit and the unitary nature of individual case is the focus of analysis. It seeks to engage with and report the complexity of social and/or educational activity in order to represent the meanings that individual actors in the situation bring to that setting. It excels at bringing us to an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Darwin's theory of evolution was based, in essence, on case study research, not experimentation, for instance. In education, this is one of the most widely used qualitative approaches of research.

Case study research method can also be defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used. Social scientists have made a wide use of this qualitative research method to examine contemporary real-life situations and provide the basis for the application of ideas and extension of methods. However, some case studies can also be quantitative in nature, especially if they deal with cost-effectiveness, cost-benefit analysis or institutional effectiveness. Many case studies have been done by combining the qualitative as well as the quantitative approaches in which initially the qualitative approach is being used and data is collected through interviews and observations followed by the quantitative approach of analysis. The approach of case studies ranges from general field studies to

interview of a single individual or group. A case study can be precisely focused on a topic or can include a broad view of life and society. For example, a case study can focus on the life of a single talented artist, his actions, behaviour, abilities and so on in his career or it can focus on the social life of an individual including his entire background, experiences, motivations and aspirations that influence his behaviour in the society.

Grounded Theory

Most of the times, research is designed with preconceived ideas towards a theoretical proposition in which data is collected in order to test the validity of the study. The feeling behind this is that you will often find out in research what you are looking for! Such approaches emphasize the generation of theory from data. A Study based on grounded theory is a reverse to this approach. In grounded theory research, a theory is generated from observations made, rather than being decided before the study. Unlike the usually research that unwittingly or wittingly look for evidence in the data to confirm or deny established theories or practices, grounded study seeks to challenge this approaches. Rather, an open mind is kept for new ways of perceiving a subject or new ways of categorising or gathering data to make discoveries or advances in nature. Hence, the aim of grounded theory is then to approach research with no preconceived ideas about what might be discovered or learned. The approach is as follows;

1. They attempt to develop categories which are derived from the data generated;
2. They attempt to give as many examples as possible in the categories developed in order to demonstrate their importance;
3. Then they develop these categories into more general and broader analytical frameworks (or theories) with relevance to other situations outside the research subject.

Meta-Analysis

It consists of the re-analysis of a collection of research studies that have been subject to separate analysis,, but not together. It is the synthesis of results from multiple studies to determine the average impact of a similar intervention across the studies. The aim of meta-analysis is to provide an integrated and quantified summary of research results on a specific question with particular reference to statistical significance and effect size (that is the size or strength of the impact of one factor on another). Meta-analysis usually requires quantitative data that is subject to statistical analysis.

Systemic Reviews

A systemic review involves the review of research available on a particular topic, based on a rigorous and predetermined methodological approach. The role of the reviewer is to select the best evidence available and to advice what the current situation is. In reviews, analysis of all the research within a particular topic or specialty is done systematically to provide a summary of the findings with the possible reasons for such outcomes. Systematic reviews are usually done by experts in a particular field or specialty who has gained a lot of experience in research to clearly organise suitable data from various research and evaluate them to make useful contributions in that field of study.

Summary Questions

1. Of what importance is research to man?
2. Of what importance is research methodology?
3. How can science and research lead to development? Describe this relationship.
4. Based on the outcomes of research, what category will contribute most to knowledge and development?
5. What type of research approach makes use of particular situations to draw inferences to general ideas or theories?

6. What type of research is based on evidence from direct observation?
7. A measurement in research that can take different values or categories is called.....?
8. What type of research study evaluates the cause-effect relationship? Describe it?
9. A research that contains both quantitative and qualitative methods is called.....?
10. What type of research seeks to explain the occurrence and cause to enhance understanding of a phenomenon?
11. What type of research can project the future?
12. What type of research study describes a situation of a population at a particular point in time?
13. A research study in which participants are recruited and followed up for a period of time is called.....?
14. A research in which data is obtained from past written document or relics is called.....?
15. The research method widely used by social scientist to describe the life episode of an individual, a group, or cooperation is called.....?

Scientific Method and Research Process

Introduction

The nature of the world is so dynamic that every single day new things are either discovered or identified. In natural science, new discoveries are made on daily basis to improve on man's nature and knowledge. This did not happen by chance but imperative that there exists a process which was put in place from the moment the idea was conceived to the time of discovery. Research process involves a lot of steps to be followed in a systematic manner to arrive at a conclusion. Before any discovery, there must have been an observation which is questionable. This observation further drives thinking which leads to the development of an idea questioning the problem. By so doing, a hypothesis is laid which can practically be tested to justify the observation. These processes are organized in a stepwise manner to attain the objective of the study. Hence, research process is the backbone of every research since it lays the foundation of the study to arrive at a meaningful conclusion.

In the previous chapter, research was simplified to its basic understanding to explain the nature, various forms, types of studies and importance in the society. This chapter will further its discussion on the processes of undergoing a research. It will focus on the key steps which are systematically followed, laying emphasis on their purpose, importance and expected outcomes in research.

Scientific Method

Science is a global term used to describe an approach of acquiring knowledge which makes use of a systematic pattern with the aim to achieve an organised evaluation, interpretation and presentation of facts. The acquisition of knowledge in science requires scientific research to draw conclusions from the findings. Thus, the defining characteristic of a scientific research employs a system known as the scientific method.

The scientific method as described by Karl Pearson is the pursuit of truth as determined by logical considerations and attempts to achieve this idea by experimentation, observation and logical arguments from accepted postulates. In the scientific method, logic aids in formulating propositions explicitly and accurately so that their possible alternatives become clear. Furthermore, logic develops the consequences of such alternatives and when these are compared with observable phenomena, it becomes possible for the researcher or the scientist to state which alternative is most in harmony with the observed facts. All this is done through experimentation and survey investigations which constitute integral parts of the scientific method. With this description, the scientific method can be applied in various fields such as natural science, social science, public health, engineering , medicine etc. It is one and same in the branches of science and it is the method of all logically trained minds.

The scientific method is considered as a systematic process for the acquisition of new knowledge in science. Thus, it can effectively be used to distinguish science from non-science. From its name, one may erroneously believe the scientific method is actually a single method but it is not. Rather, it is an overlapping stepwise procedure on how scientific investigations should proceed. It is a set of research principles and methods that help to lead researchers through their research studies to obtain valid results. Because the scientific method deals with the general approach to research rather than the content of specific research studies, it is used by researchers in all the different disciplines in science. In a nutshell,

the scientific method is that which provides a set of clear and agreed upon guidelines for gathering, evaluating, interpreting and reporting information in a research study.

The scientific method is thus based on certain basic postulates which can be stated as follows;

1. It relies on empirical evidence which are based on facts and experimentation;
2. It utilizes relevant concepts and theory;
3. It is committed to only objective considerations;
4. It presupposes ethical neutrality, i.e., it aims at making only adequate and correct conclusion;
5. It must be free from bias or minimize bias;
6. Make statements about population objects;
7. It results into probabilistic predictions;
8. Its methodology is made known to all concerned for critical scrutiny before use in testing;
9. Results must be replicable;
10. It aims at formulating new scientific concepts and theories.

The Empirical Approach

Though scientific research was generally accepted globally, there had been some disagreement among researchers over the years regarding the main elements that compose the scientific method until the eighteen century when the scientific method was accepted as the defining feature of scientific research. Since then, researchers have generally agreed that the scientific method is based on the empirical approach.

The empirical approach is an evidence-based approach that relies on direct observation or facts and experimentation in acquiring new knowledge. In this approach, scientific decisions are made based on the data derived from direct observation and experimentation. With its emphasis on direct, systematic, and careful observation, the empirical approach is best considered as the guiding principle behind all research conducted in accordance with the scientific

method. It is thus composed of the following key elements; observations, questions, hypotheses, experiments, analyses, conclusions, and replication.

Observation

This is an aspect which is hardly considered when describing the key steps in conducting a research. However, if not the most important, it is the bedrock or foundation of a research. Before carrying out a research, one must have observed something which he or she feels is abnormal and requires an answer. This process of observing is fundamental in making a decision whether to embark in a research or not. It becomes fundamental to clearly define it and its importance in a research.

Observation in research refers to two distinct concepts: being aware of the world around us and making careful measurements.

Being aware of the world around us simple mean we must be vigilant to notice certain changes beyond normal, identify new emerging issues or being inquisitive to know more about us and the world. This can be achieved only if reasoning is accompanied to make careful measurements in our minds.

Observation also refers to the process of making careful and accurate measurements; intrinsic evaluation without any practical implementation which is a distinguishing feature of well-conducted scientific investigations. When making measurements in the context of research, scientists typically take great precautions to avoid being biased in their observations.

This observation of the world around us will be developed into an idea which often gives rise to the questions that are addressed in a scientific research. For example, before Newton developed the theories of gravity, he was observant to notice the fall of an apple from a tree to the ground and made careful measurements by reason which propel him to conduct research that led to the postulation of the law of gravity. Therefore, a keen eye to your surroundings can often provide you with many ideas for research studies. In the

context of science, observation means more than just observing the world around us to get ideas for research. Research ideas can be gotten from observations made by extensive review of literature through constructive criticism.

Questions

After getting a research idea from our observations, it is obvious we will want to question those observations. The next step in the research process involves translating that research idea into an answerable question. The term "answerable" is particularly important in this context of research and it should not be minimized. Answerable question simply mean a question that can be tested using a scientific method.

It would obviously be unrewarding and frustrating if one tries to answer an "unanswerable" research question through scientific investigation. An example of an unanswerable research question is the following: "Can fertilization occur in Jupiter?"Although this is certainly an interesting question that would likely yield important information, the current state of science and technology cannot provide an answer to this question since no one has ever visited Jupiter. Hence, it is therefore important to formulate a research question within the scope of the available scientific methods and procedures.

There exist two categories of research questions; those which relate to the states of nature and those which relate to relationships between variables. Those questions that relate to nature are explanatory and descriptive. They seek to know the properties, constituents and composition of living things in the surroundings and society. They also seek to know their occurrence, origin, understand their functioning and evolution. Questions that relate to relationships between variables are aimed at making careful comparisons to observe differences which can help to identify the cause of certain problems.

Hypothesis

With a question in mind, the next thing one will want to do in a research is to provide answer to it. After a thorough review of the existing literature, one can possible make a guess to the answer which he will be able to test. This drives us to our research hypothesis.

Hypothesis is simply an educated and testable guess about the answer to your research question.

In other words, a hypothesis can also be described as an attempt by a researcher to explain the phenomenon of interest. A key feature of all hypotheses is its ability to make a prediction. Since hypotheses are the researcher's attempt to explain a phenomenon being studied, prediction would be involved in giving an explanation about the variables being studied. These predictions will then be tested by gathering and analyzing data, and the hypothesis can either be supported or refuted on the basis of the data obtained. Hypothesis can typically be phrased as an "if-then" statement. For example, a researcher may hypothesize that "*if* people reduce the rate of consumption of fatty foods, *then* their blood pressure will be reduced." This hypothesis makes a prediction about the effects of fatty food consumption on blood pressure, and the prediction can be tested by collecting and analyzing data.

There are two research hypotheses usually stated; the alternate (experimental) and null hypothesis. The alternate hypothesis predicts that there will be a difference between the groups while the null hypothesis is in contrast to that. Rather, the null hypothesis always predicts that there will be no differences between the groups being studied. Based on the example above, the null hypothesis would predict that there will be no significant difference of blood pressure in the fatty food consumption group and the non-consumption group. In contrast to this, the alternate hypothesis would predict that there will be a significant difference of blood pressure in the fatty food consumption group and the non-consumption group.

Hypothesis can help to provide systematic connection between concepts. By organising concepts into statements, hypothesis helps to make sense out of what we observe. It also facilitates the testing of scientific theories. Hypothesis can take various forms depending on the question being asked and the type of study being conducted. It can be classified as follows;

1. Univariate or Multivariate
2. Associational or Non-associational
3. Universal or Statistical
4. Temporal or Cross-sectional

Univariate or Multivariate

Univariate hypothesis assigns a value (category) of a variable to a unit (individual, group, event or object) of observation. This simply means a hypothesis with one variable. For example, voting turnout in Nigeria is 60%. This is a univariate hypothesis because it assigns the value "60%" to the variable "turn-out" to a unit of observation "Nigeria". Since univariate hypothesis has only one variable, they cannot be associative or universal but descriptive in nature. They are not usually statistically tested for differences or truthfulness, but can be the case if there is a known theoretical value of the variable. For example, if we embark on a research to determine the mean sugar level of a population and we know the theoretical mean sugar level, we can statistically compare the experimental and theoretical values for any difference.

Multivariate hypotheses are statements that relate two or more variables. For example, human weight varies with age. Here, there are two variables involved; weight and age. This type of hypothesis can be associative and statistically tested. It is one of the most commonly used hypotheses employed in the majority of research in social science and public health as well as natural science.

Associational and Non-associational hypothesis

Associational hypothesis specify that two or more variables are related. They may be directional specifying whether the variables

are related positively or negatively. For example, if income increases and development also increases will indicate a positive relationship. On the contrary, if income increases and development reduces will be a negative relationship.

Non-associational hypothesis specify that two or more variables are not related. Such a hypothesis is usually called the null hypothesis meaning no relationship. For example, a research on the effect of smoking on lung cancer shows no significant differences (no association).

Universal and Statistical hypothesis

Universal hypothesis takes the form; if X, then Y. It is usually indicated by words such as "always" and "never". This type of hypothesis is that which is always true universally. It is mostly used in mathematical research. For example, if one plus two is three, then x+y is true for all positive integers.

Statistical hypothesis is that which can statistically be presented. It is mostly useful for descriptive research. For example, if the house of representative is incumbent, there is a 90% probability for him to win.

Temporal and Cross-sectional hypothesis

Temporal hypothesis states that one variable precedes the other with time. For example, if wages increase, prices will increase at later time. Temporal hypothesis usually predict causality because one thing leads to the other. On the other hand, cross-sectional hypothesis states that variables occur at the same point or section in time. Unlike temporal hypothesis, they do not imply causality.

For a statement to be considered as a hypothesis, it should have the following characteristics;

Deductibility: For a hypothesis to be of a scientific importance, it must have a theoretical background. That is, it is derived from a theory or other statements in a theory. Hypothesis that lack deductibility do not permit scientific explanations and predictions.

Testability: For a statement to be considered as a hypothesis, should be capable of being confirmed or disconfirmed wit observational units. Testing a hypothesis means to develop method which will practically assess the statement. If there is n practical method to assess a statement, then it is not considered hypothesis.

Operational defined concepts: A hypothesis should have operational defined concepts. That is, concepts that are defined in terms of observational characteristics. Hypotheses that contain concepts that cannot be defined operationally are not testable, hence inadequate as a scientific hypothesis.

Methodology

Once a hypothesis has been defined, the next thing to do is to put in place a methodology to test it.

Research methodology is the sum of all the methods and procedures put in place to test the hypothesis

It is a stepwise procedure in a chronological order of all the activities to be experimented practically in the research. However, before this happens, a plan or design needs to be developed to direct the experimental process.

Research design is a plan or blueprint on how to conduct a research.

Researchers are often confused between a research design and research methodology and are unable to distinguish them. A simple explanation to this is that a research methodology is the totality of all the methods and processes put in place including a research design to test a hypothesis. On the other hand, a research design is a plan which is put in place to direct the research methodology. Thus, research design is a subset of a research methodology. This can be better explained with this example.

Consider you want to construct a house and develop an idea to build a duplex It will be necessary to develop an architectural plan that will suit the construction design of a duplex. After the plan or design has been put in place, the tools, materials and various methods of building in respect to the design will be implemented to obtain a duplex. If this was to be a research study, then the following considerations will be made. The first aspect here is the idea to construct a duplex which clearly reflects our research aim. The architectural plan reflects a research design which is a plan that serves as a platform for the construction process. And finally, the methodology will therefore involve all the methods, processes and activities including the research design that are implemented to construct the duplex.

Data collection and analysis

After conducting an experiment, data needs to be collected so that they can be analysed. There are several ways of collecting the appropriate data which differs considerably in the context of monetary cost, time and other resources at the disposal of the researcher. Primary data can be collected either through experiment or through survey. If the researcher conducts an experiment, he observes some quantitative measurements, or collect data of which he will examine the truth contained in his hypothesis. But in the case of a survey, data can be collected either by observation, personal interview, telephone interview, mail response, questionnaires etc. The researcher should select one of these methods of collecting the data taking into consideration the nature of the investigation, objective and scope of the inquiry, financial resources, available time and the desired degree of accuracy. Though he should pay attention to all these factors, much depends upon the ability and experience of the researcher. Following data collection is the analysis of the results to clearly explain the hypothesis.

Analysis can take different forms depending on the nature of the study and the type of question being addressed. Certain qualitative studies; usually exploratory will analyse results by comparing it with

previous studies and facts available. Some other types of research such as descriptive, causal or predictive will go further to use mathematical and statistical methods to analyse data. The type of statistical technique used by a researcher depends on the design of the study, the type of data being gathered, and the questions being asked. The analysis of data requires a number of closely related operations such as the establishment of categories, the application of these categories from raw data through coding, tabulation etc. and then drawing statistical inferences.

Conclusion

After data analysis, the researcher is now in a position to determine whether to reject the null hypothesis or not which he will use to draw a conclusion on the study. For example, a researcher can confidently conclude that the phenomenon being studied had a statistically significant effect if the null hypothesis was rejected.

In research, only those conclusions that are supported by data analysed from the result should be made. Any decision contrary to this is wrong and must be avoided. For example, if a researcher conducts a correlational study and the results indicated that the two things being studied were strongly related, the researcher cannot conclude that one thing is the cause of the other because he did not test for causality. In other words, the fact that two things are related does not necessarily mean that one is the cause of the other. Also, we should know that based on the results of the study, certain aspects which were not tested but have links or are related to the conclusion may be presented as recommendations or perspectives for future implementation or further research respectively.

Replication

Replication is one of the most important elements of the scientific method and another aspect of research which is usually not cited among the steps of the empirical approach.

Replication is the act of conducting the same research study a second time with another group of participants to obtain the same effect as the first.

Importances of replication in research are numerous and serve for several purposes. It could be used to evaluate the reliability or consistency of the research findings as well as investigate whether the same result can be obtained with a different group of participants. This last point refers to whether the results of the original study could be generalised to other groups of research participants. In other words, this means that if the result of a study is replicated, then, the researcher has greater confidence in the reliability and generalisability of the work.

The Research Process

Developing an Idea

As earlier stated, the first step of a research is to make careful observations of the world around us to develop ideas which will be translated to a research question. These observations are very important because they serve as a platform for which ideas can be developed. To be a good researcher, you must be curious about the world around you either to understand certain changes or to identify new phenomena. Observation of the world around us exists in different forms. Certain observations may be physically observed while others can only be observed microscopically. Some observations may be made after certain manipulations while others may be by intensive literature search. One thing that is certain is that once an observation is made, it can easily be transformed to a research idea. Research idea is a thinking related to the observation to better understand a phenomenon. It can be done by mere thinking, but will also require intellectual background to support your thoughts. Research idea is usually presented in the form of a research question which will trigger a research process to answer it.

Choosing a Research Topic

Once a research idea has been developed, it needs to be defined as a research topic.

A research topic is a statement that expresses the research idea, the scope and its limitation.

This statement is usually a broad one containing the operational terms and concepts of the topic as well as the variables to be studied. In choosing a topic, a researcher can be influenced by a number of factors which may non-exhaustively includes the researchers' academic interest, the interest to solve a problem, its relation to previous research and theories and the prospects for new concepts and theories

Research Motivations

Academic Interest: For something to be pertinent, it must have certain characteristics that are accepted by you. For examples, for someone to say this girl is beautiful, he must have seen certain features or qualities in her that interest him. This example presents a situation of our interest in research. Observations that can easily be developed to research ideas are those of the researcher's interest. For a researcher to develop an interest in a research there is likelihood that the observation may have certain characteristics or questions which are of interest to be addressed. The interest may develop from various perspectives, but most likely will be the case if the event or issue observed is within the scope of the researchers discipline or specialty. A biochemist may not pay much attention to a research that is not closely related to his field of study. For example, a biochemist may not develop interest to investigate whether crude oil subsidies can affect the welfare of the society but may be interested to find out whether fuel can be obtained from certain biological substances. One's field of study or discipline will trim or shape his idea towards that direction and will be interested to develop ideas based on what he knows or is grounded in.

New Phenomenon: One of the motivations in conducting a research may be as a result of a new observed phenomenon which has not

been observed before or new ideas which have not been exploited. Once a lot of research has been done in a particular subject or event, there are rarely some challenging questions which are still to be addressed. Such issues cannot easily motivate someone to further research on them. However, if a new phenomenon arises which is strange to the society, challenging questions will be posed to address it. For example, HIV virus was discovered only after people were observed to die as a result of a syndrome (a new phenomenon) which did not exist before. This motivated research in that area which led to the discovery of the cause of that sickness.

Academic Advancement: Another motivation for conducting a research is the fact that research is included as one of the means of advancing knowledge both in the academic world and in the society and getting promotion in a career. Academic advancement in research is paramount, particularly in postgraduate studies. It becomes fundamental for one to undergo a research to advance his knowledge in a particular field of study so as to be recognized for his contribution to knowledge in that discipline.

Problem Solving: The world is so dynamic that certain changes can either solve or create a problem. The nature of the world itself is an avenue for creating new problems. On a daily basis, new phenomena are being created in various aspects such as new illnesses, socioeconomic, political, cultural, technological problems, etc. One of the ways to solve these problems is to identify the cause so that solution can be developed to manage them. Through research, the cause of certain problems can be identified and measures on how to manage them will be developed. One of the essences of conducting a research is to solve some particular problems in the society. This serves as a motivation for researchers to embark on research to develop such ideas that can lead to problem resolution in the society.

Previous Research: Previous research often serves as a baseline for new research, whether conducted by the same researcher or by another. Previous research serves as a platform for identifying gaps and lapses in certain disciplines which are kept in perspectives for

further findings. Researchers will likely attest that previou conducted research is a rich and plentiful source of research ide This motivation may be to confirm certain previous findings improve on the methodology of a previous research, to replica certain studies in other areas where similar problems are bei observed, contradict the ideas presented in a previous research or validate them. In fact, it is often said that "research begets researc primarily because research tends to raise more questions than answers, and those newly raised questions often become the focus future research studies. In other words, as a research solves problem, more are created for new findings.

Formulate a Research Problem

After observation, it is obvious that a researcher will start to develo ideas on the theoretical judgments made on the phenomenon. The best way to express these ideas is to ask questions why the situation or phenomenon is like that. This will then be presented as the research question.

A research question can be defined as a specific question in a research that addresses the problem in a concise way to identify the key operational units and variables.

The research problem typically takes the form of a concise question regarding the relationship between one or more variables. Some examples of a research question include;

- Can plant extract lower the blood sugar level of the body?
- Can teaching method improve students' performance?
- What is the prevalence of malaria in Nigeria?
- Is oxidative stress a prevailing factor of communicable diseases?

These are just a few of the various forms a research question can be presented. Research questions can take different forms depending on the type of problems it wants to address. For example, one can observe that fat people easily develop heart disease. If the researcher wants to address the problem in terms of relation, then he can formulate a research question as thus: Is there any

relationship between fat accumulation and heart disease? On the other hand, if the researcher intends to determine the cause, the question will be addressed as thus: Is fat accumulation the cause of heart disease?

Another important aspect in defining a research question is to be concise and specific enough not to miss out the key variables and to clearly use the operational definitions of the subject. Any research question that does not clearly define the variables and the operational definitions will be vague and often results in methodological confusion, because the research question does not clearly indicate what or who is being studied. Through the use of operational definitions, researchers can clearly and specifically identify what or who is being studied. Operational definitions are useful to define key concepts and terms in the specific context of a research study.

Another benefit of a research question is that it helps to ensure uniformity in definitions such that a particular term or phenomenon is understood by everyone. Among other things, this will greatly assist future researchers who attempt to replicate a given study's result or make use of the methods for further findings. Obviously, if a researcher is unable to determine or understand what or who is being studied, they will certainly not be able to replicate the study. For example, a researcher may want to study the effect of cigarette smoking on lung toxicity. In this example there are two key concepts that need to be clearly defined for this topic because cigarette smoking and toxicity are very broad. One may define cigarette smoking as 10, 20, 50 sticks per day and toxicity as acute, sub acute, chronic, etc. If they are not clearly defined, the research problem may not be explicit enough to be tested and analysed.

Literature Review

After having developed a research idea and a topic has been defined to address a research question, the next step in a research study is to review the existing literature in that subject area. The primary purpose of a literature review is to help researchers become familiar

with the works or studies that have already been conducted in th selected topic area. A thorough literature search is needed to defin and explain all the terms and concepts of that topic clearly to hav factual information. For example, if a researcher decides t investigate the effect of a treatment, say coartem on simple malari in Nigerian children, it would be important for him or her to have a understanding of all the terms in the topic such as simple malaria prevalence of malaria in Nigeria, causes of malaria in children treatments of malaria, coartem etc. Defining and understanding all o these terms will give the researcher a clue on how to develop th research hypothesis.

Literature reviews are absolutely indispensable when planning a research study because they can help to guide the researcher in an appropriate direction by answering several questions relating to the subject area. Some examples of possible questions usually addressed during the process of literature review include the following; Is there any existing research done in this topic area? What do the findings of the studies suggest? Were there any unforeseen methodological difficulties of which future researchers should be aware when planning or conducting studies? Is there need for more research to be conducted on this topic, and if so, in what specific areas? A thorough literature review should be able to answer these questions and relate them, thereby helping to set the stage for conducting the research.

A well-conducted literature review will often reveal the status of a study whether it has already been conducted by others or not. It is important to know this fact sooner rather than during the planning phase of a study to prevent waste of resources, time and energy. Sometimes, extensive literature review may help researchers to change the focus or methodology of their studies based on the types of studies that have already been conducted. Literature review has the capacity to direct the research on the choice of methods; that is, the techniques, data collection and analysis methods that need to be employed as well as the type of study design to be used. From literature, the researcher will also be directed on how to choose or

define the research hypothesis. Hence, a thorough literature review is almost considered as half the work done in conducting a research.

Articulate Hypothesis

After literature has been reviewed, the next step is to anticipate the outcome of the research question. However, this anticipated result is simply a guess or prediction since it has not been tested but can serve as a guide to attain the study's objective. This guess or prediction is what we call the hypothesis of the study. Hypothesis is another step in the planning phase of a research that can sometimes be challenging and intimidating for inexperienced researchers. Articulating hypothesis is one of the most important steps in the research planning process, because a poorly articulated hypothesis can ruin the entire study which would have been an otherwise good study.

Hypotheses attempt to explain, predict, and explore the phenomenon of interest in one or more variables. Because it is a thought of the researcher's educated guess about how the study will be conducted, it is logical to stem from the research problem being investigated. Certain characteristics are necessary for a good hypothesis;

Hypothesis must be falsifiable: As a guess, hypothesis is something that can have two options; either true or false. Thus, it must be capable of being refuted based on the results of the study. A research is sometimes that which can be in support of your claims or be against them. If a researcher's hypothesis cannot be refuted, then the researcher is not conducting a scientific investigation because a hypothesis is a guess or a prediction and not definite or unidirectional. This simply means that research hypothesis is bidirectional; that is can either be confirmed or rejected.

Hypothesis must make a prediction: Since hypotheses are merely guesses which have not been tested and proven, but are just anticipating a situation, it must be able to make a prediction of the outcome. The predictions embodied in hypotheses are subsequently

tested empirically by gathering and analyzing data, and th hypothesis can then be either supported or refuted.

Hypothesis can exist in two forms; the alternate hypothesis and it negation, the null hypothesis.

Null Hypotheses and Alternate Hypotheses

The alternate hypothesis is usually the hypothesis which usually predicts the anticipated outcome of the research while the null hypothesis refutes, rejects or contradicts the anticipated outcome. This is the general scenario and mostly applicable for univariate or single group studies. However, in research studies involving two groups of participants (e.g., experimental group versus control group), the null hypothesis always predict that there will be no differences between the groups being studied. By contrast, the alternate hypothesis always predicts that there will be a difference between the groups being studied (or a relationship between the variables being studied). If a particular research study does not involve groups of study participants, but instead involves only an examination of selected variables, the null hypothesis predicts that there will be no relationship between the variables being studied while the alternate will predict a relationship.

To clearly explain the difference between the null hypothesis and alternate hypothesis, the following example will be used. In a research study to investigate the effect of a newly developed medication on the blood sugar level of the body, the null hypothesis would predict that there will be no difference in terms of the blood sugar level between the group that received the medication (i.e., the experimental group) and the group that did not receive the medication (i.e., the control group). By contrast, the alternate hypothesis would predict that there will be a difference in the blood sugar level between the two groups. Thus, the alternate hypothesis may predict that the group that received the new medication will experience a greater reduction in the blood sugar level than the group that did not receive the new medication.

In scientific research, keep in mind that the alternate hypothesis is the research hypothesis which is usually applied and tested experimentally to obtain results while the null hypothesis is the statistical hypothesis which is tested statistically to either confirmed or refuted (sometimes phrased as rejected or not rejected) a phenomenon. It should also be noted that if the null hypothesis is rejected after statistical analysis, the researcher can reasonably conclude with certainty that there is a difference between the groups being studied. Rejecting the null hypothesis allows a researcher to 'not reject' the alternate hypothesis, and not rejecting a hypothesis is usually the aim of a scientific research. It should equally be noted that we do not 'accept' a hypothesis; we can only fail to reject a hypothesis because testing is based on the null hypothesis which is not the research hypothesis. It is important to know that the researcher's goal of a research is typically to reject the null hypothesis thereby empirically demonstrating that there is a difference in the groups being examined in the study.

Identification of Variables

Once a research hypothesis has been developed, it is necessary for the variables to be identified to facilitate the design of the study. In some earlier sections of this book, we have been talking about variables without clearly understanding and describing them.

A variable is any unit measurement that can take different values or changes

Some examples include, sex, age, height, colour, weight, location, race, species, etc. When dealing with research, some of these measures are frequently evaluated. Variables can be classified in various ways depending on the aim of the research. They can either be classified as dependent or independent, categorical or quantitative, discrete or continuous etc. Here, our main focus will be on independent and dependent variables. The others will be described in our subsequent chapter on types of data.

Referencing Style

The Harvard System of Referencing

This guide is intended to provide you with advice on how to use the Harvard (author-date) system where you supply the author's name and the date of publication of the document referred to *within the text.*

1. A note about dates and page numbers

If no date can be established you can use n.d. e.g. Webb (n.d.)
If the date can be established but only approximately you should use c. e.g. Webb (c.2012)
Electronic books read via an e-reader such as the Kindle do not have traditional page numbers. In this case, use the chapter numbers instead for indicating the location of a quoted section:
If you wish to cite a web resource that does not include page numbers, you can include any of the following in the text to cite the quotation:

- A paragraph number, if provided; alternatively, you could count paragraphs down from the beginning of the document:
- An overarching heading plus a paragraph number within that section:
- A short title in quotation marks, in cases in which the heading is too unwieldy to cite in full:

2. Citations in the text

All ideas taken from another source regardless of whether directly quoted or paraphrased must be referenced in the text of your assignment. To link the information you use in your text to its source (book, article, etc.), put the author's name and the year of publication at the appropriate point in your text. If the author's name does not naturally occur in your writing, put the author's surname and date in brackets.

So if the author's name is James Robert Jones, you would use the surname Jones and the date to cite in the text.
e.g. Jones (2011, chapter 6) states that...
e.g. British Medical Association (2012, para. 2) states that...
e.g. NHS (2012, Migraines, para. 3) states that...
e.g. NHS (2012, Risks section, 'Driving and mobile phones') states that...
e.g. There is some evidence (Jones, 2012) that these figures are incorrect.

If the author's name *is* part of the statement, put only the year in brackets:
If there are **two or three authors**, give all:
Note: if you are giving a **direct quotation** then you need to include the **page number**.
If there are **more than three authors**, cite only the first followed by 'et al.' (which means 'and others'):
If an author has published more documents in the same year, distinguish between them by adding lower-case letters:

Secondary referencing
When an author quotes or cites another author and you wish to cite the original author you should first try to trace the original item. However, if this is not possible, you must acknowledge both sources in the text, but only include the item you actually read in your reference list.
Then cite Jones in full in your reference list.

Information found in more than one source
If you find information in more than one source, you may want to include all the references to strengthen your argument. In this case, cite all sources in the same brackets, placing them in order of publication date (earliest first). Separate the references using a semi-colon (;).
e.g. Jones (2012) has provided evidence that these figures are incorrect.

e.g. It is claimed that government in the information age will "wo
better and cost less"
(Bellamy and Taylor, 1998, p.41).
e.g. ...adoptive parents were coping better with the physic
demands of parenthood and found family life more enjoyable (Le
et al., 1991).
e.g. In recent studies by Smith (2013a, 2013b, 2013c)...
e.g. If Jones discusses the work of Smith you could use:
Smith (2012) as cited by Jones (2013)
or Smith's 2012 study (cited in Jones, 2013) shows that...
e.g. Several writers (Jones, 2011; Biggs, 2012; Smith, 2013) argue...

3. Reference List/Bibliography

Full references of sources used should be listed as a reference list at the end of your work. This list of references is arranged alphabetically usually by author. You may also be required by your tutor to include a bibliography which should list not only all items used within the text but also any other sources you have read as part of your research. Examples of these can be found at the end of journal articles or books (but might not be in Harvard style).

Example of a Reference List

ASHTON, F. (1948) *Cinderella.* [Royal Opera House, London, 13th January 2004].

CHAN, T.M. (2011) Three problems about dynamic convex hulls. In: *Proceedings of the 27th Annual Symposium on Computational Geometry, Paris, June 2011.* New York: ACM, pp. 27-37.

MAIMON, D. and BROWNING, C.R. (2012) Adolescents' violent victimization in the neighbourhood: situational and contextual determinants. *British journal of criminology*, 52 (4), pp. 808-833.

MALTZMAN, R. and SHIRLEY, D. (c.2011) *Green project management.* London: CRC Press.

Whenever possible, elements of a bibliographical reference should be taken from the title page of the publication or from the library catalogue. Each reference should give the elements and punctuation as found below. Authors should always be in capitals, followed by the date in brackets. In the following examples, the source (e.g. title)

It is claimed that government in the information age will "work better and cost less"
(Bellamy and Taylor, 1998, p.41).

e.g. ...adoptive parents were coping better with the physical demands of parenthood and found family life more enjoyable (Levy et al., 1991).

e.g. In recent studies by Smith (2013a, 2013b, 2013c)...

e.g. If Jones discusses the work of Smith you could use:
Smith (2012) as cited by Jones (2013)
or Smith's 2012 study (cited in Jones, 2013) shows that...

e.g. Several writers (Jones, 2011; Biggs, 2012; Smith, 2013) argue...

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has been *italicised*; you can also emphasize the source by underlining or typing in **bold**. It does not usually matter which you use, so long as you are **consistent** throughout your reference list.
If the author is James Robert Jones this will become JONES, J.R.
Abdul-Rahman Al-Haddad would be AL-HADDAD, A.
If there is no author use ANONYMOUS.

3.1 References – Books

Books

AUTHOR(S) (Year) *Title*. Edition – if not the 1st. Place of publication: Publisher.

Books with two or three authors

Books with more than three authors – give the name of the first author, followed by 'et al.' (and others).

e.g. CLARKE, S. (2011) *Textile design*. London: Laurence King.

e.g. SEIDMAN, S. (2012) *Contested knowledge*. 5th ed. Hoboken, New Jersey: Wiley-Blackwell.

e.g. LIGHT, G., COX, R. and CALKIN, S. (2009) *Learning and teaching in higher education: the reflective professional.* 2nd ed. London: Sage.

e.g. SHAW, R. et al.. (2011) *Management essentials for doctors.* Cambridge: Cambridge University Press.

Books with one or more editor(s) – Include the abbreviation (ed./eds.) after their surname.

EDITOR(S) (ed./eds.) (Year) *Title*. Edition. Place of Publication: Publisher.

Chapters in books

AUTHOR(S) (Year) Title of chapter. In: AUTHOR(S)/EDITOR(S), (ed./eds.) *Book title*. Edition. Place of publication: Publisher, Pages, use p. or pp.

Note: Electronic books should be cited exactly the same as print, following the rules above.

3.2 References – other sources

Journal articles

OR(S) (Year) Title of article. *Title of journal*, Vol. no. (Part sue/Month), Pages, use p. or pp.

t Journal articles taken from the Internet or a database should ted as print using the rules above.

y Include the web address or database name if there are no page nbers and just use the main web address, not the unique address he individual article.

wspaper articles

THOR(S) (Year) Article title. *Newspaper title*, Day and Month bbreviated). Pages, use p. or pp.

here there is no page number e.g. for an online newspaper use the urce, and add the date accessed.

Newspaper articles taken from the Internet or a database should be lted as print using the rules above.

Only include the web address or database name if there are no page numbers and just use the main web address, not the unique address of the individual article. e.g. http://www.guardian.co.uk not ttp://www.guardian.co.uk/business/2012/aug/08/bank-of-ngland-cuts-uk-growth-forecasts.

.g. FURSE, A. (ed.) (2011) *Theatre in pieces: politics, poetics and nterdisciplinary collaboration: an anthology of play texts 1966-2010*. ondon: Methuen Drama.

.g. TUCKMAN, A. (1999) Labour, skills and training. In: LEVITT, R. t al. (eds.) *The reorganized National Health Service*. 6th ed. heltenham: Stanley Thornes, pp. 135-155.

.g. MAIMON, D. and BROWNING, C.R. (2012) Adolescents' violent ctimization in the neighbourhood: situational and contextual eterminants. *British journal of criminology*,
2 (4), pp. 808-833.

g. STAMM, M.C. et al. (2013) Information forensics: an overview of ıe first decade.
EE Access, 1. Available from http://www.ieee.org/IEEEAccess.

g. ALDRICK, P. (2014) It's not just academic: universities could ake a difference to Britain's exports. *The Times*, 9th Jan. p. 45.

g. GOODLEY, S. (2012) Bank of England cuts UK growth forecasts. *uardian*, 8th Aug.

Available from: http://www.guardian.co.uk [Accessed 20/10/13].

Systematic reviews (for example, from the Cochrane Library)

AUTHOR(S) (Year) Title of review. [Systematic Review] *Title of source,* Issue. [Accessed date].

Image(s) or Diagram(s) within a book

Where the image or diagram cited from a book is the work of the author use the citation for the book and add the page number as you would for a direct quote.

Where the image or diagram cited from a book is **not** the work of the author, additional reference to the work should be made, as follows:

Image:

ARTIST (Year) Title of the work. [Material type]. At or In: (where found, for example in a book or museum).

AUTHOR(S)/EDITOR(S) of book (Year) *Title.* Edition. Place of publication: Publisher, Page number. or

Diagram:

Papers in conference proceedings

AUTHOR(S) (Year) Title. In: *Title of conference proceedings. Place and date of conference* (unless included in title). Place of publication: Publisher, Pages, use p. or pp.

Publications from a corporate body (e.g. Government publications)

NAME OF ISSUING BODY (Year) *Title.* Place of publication: Publisher, Report no. (where relevant).

Note that where the author is a government body, the country becomes the author. If an official report has individual authors these should not be used; instead use the name of the official body.

e.g. GRANT, N.H. et al. (2013) Elective preterm birth for fetal gastroschisis. [Systematic Review] *Cochrane Database of Systematic Reviews*, Issue 6. [Accessed 17/07/13].

e.g. MASOLINO, T. (1427) The Temptation of Adam and Eve. [Painting] In: BRUCE-MITFORD, M. (1996) *The illustrated book of signs and symbols.* London: Dorling Kindersley, p. 63.

e.g. MINTZBERG, H. (1979) The basic parts of organisations – Mintzberg's model. [Diagram].

In: COLE, G.A. (2004) *Management theory and practice.* 6th ed. London: Thomson, p. 186.

e.g. CHAN, T.M. (2011) Three problems about dynamic convex hulls. In: *Proceedings of the 27th Annual Symposium on Computational Geometry, Paris, June 2011.* New York: ACM, pp. 27-37.

e.g. GREAT BRITAIN. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1988) *Report of the enquiry into child abuse in Cleveland.* London: HMSO, Cm 413.

Legislation

Legislation includes Acts of Parliament (also known as Statutes) and Statutory Instruments (also known as Rules, Orders and Regulations).

Legislation does not have an author.

Acts of Parliament

Title of the Act and year (chapter number of the act; abbreviated to 'c.'). Place of publication: Publisher.

Statutory Instruments

Title of the Statutory Instrument and year (SI year/number). Place of publication: Publisher.

Market research reports

NAME OF ISSUING BODY (Year) *Title, date (if available).* Edition (if available). Place of publication: Publisher, Report no. (if relevant)

British Standards

These rules can be applied to all standards.

NAME OF AUTHORISING ORGANISATION (Year of publication) *Number and title of standard.* Place of publication: Publisher.

e.g. The Cleveland Enquiry – see GREAT BRITAIN. DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1988).

e.g. Cadbury report – see COMMITTEE ON THE FINANCIAL ASPECTS OF CORPORATE GOVERNANCE (1992).

COMMITTEE ON THE FINANCIAL ASPECTS OF CORPORATE GOVERNANCE (1992)

*Report of the committee on the financial aspects of corporate governance (Cadbury Report).*London: Gee.

e.g. *Environment Act 2005* (c. 25). London: The Stationery Office.

e.g. *Insolvency Rules 1986* (SI 1986/925). London: HMSO.

e.g. MINTEL (2012) *Coffee: Mintel marketing report, April 2012.* London: Mintel International. **or** KEY NOTE (2012) *Footwear: Key Note market report plus.* Hampton: Key Note.

Theses and dissertations

AUTHOR (Year) *Title.* Designation (Level, e.g. MSc, PhD.), Institution.

Exhibition catalogues

ARTIST (Year) *Title of exhibition.* [Exhibition catalogue including place and date] Place of publication: Publisher.

Music scores

COMPOSER (Year) *Title.* [Music score] Place of publication: Publisher.

3.3 References – Live Performance

Dance

COMPOSER or CHOREOGRAPHER (Year of premiere) *Title.* Company (optional). [Location, Date seen].

Plays

Title by Author. (Year of performance) Directed by add DIRECTOR'S NAME. Company (optional). [Location, Date seen].

3.4 References – Electronic or audiovisual

Electronic books and electronic journals should be cited in the same way as print, using the guidelines in sections 3.1 and 3.2 respectively.

The principles for citing electronic resources are the same as for other formats; use the author and date of publication in the text, then follow the convention as detailed below. The nature of web resources means that author names are often not available and dates can be very vague. You will therefore need to decide who is responsible for producing the web page and use them as the author; often this will be an organisation rather than a personal name. You should be able to find this information by following 'about us' or 'contact us' links.

e.g. BRITISH STANDARDS INSTITUTE (2008) *BS ISO 8178-2: Reciprocating internal combustion engines – exhaust emission measurement.* London: British Standards Institute.

e.g. FENG, W. (2010) *Remote service provision for connected homes.* Unpublished thesis (PhD.), De Montfort University.

e.g. HARRIS, W. (1983) *William Harris as designer.* [Catalogue of an exhibition held at theWhitworth Art Gallery, 3 May – 4 June 1983] London: Arts Council.

e.g. BACH, J.S. (1970) *Organ music.* [Music score] New York: Dover Publications.

e.g. ASHTON, F. (1948) *Cinderella.* [Royal Opera House, London, 13th January 2004].

e.g. *An inspector calls* by J.B. Priestley. (2009) Directed by STEPHEN DALDRY.
[Arts Theatre, Cambridge, 11th May 2009].

If there is no author or organisation you can use the title of the web page. If there is no title use a truncated web address (**you should consider whether this resource is suitable for academic work**).

Web pages

Electronic references should contain the following elements:
AUTHOR(S) (Year) *Title of document.* [Type of resource] Organisation responsible (optional). Available from: web address [Accessed date].

If you are referencing an electronic journal article, newspaper article or book, use the standard referencing format for that item. Guidelines can be found above.

Note: Dates are not always available for web pages. If this is the case use (n.d.) where n.d. represents no date so that the reader knows you have omitted this element.

Computer games

AUTHOR(S) or ORIGINATOR(S) (Year) *Title of game.* [Medium of item, i.e. DVD, CD or Online] Platform (Xbox, PC etc). Place of Publication: Publisher.

Software

Individual authors are rarely acknowledged. If you cannot find a named author of an electronic source then use the organisation or title in place of the author.

AUTHOR(S) or ORIGINATOR(S) (Year) *Title.* [Software] Version/series etc. Place of publication: Publisher.

E-mail messages from a public domain e.g. discussion **boards** or conferences.

AUTHOR (of message) (Year) Subject of the message. [Online] *Electronic conference or bulletin board,* Day/month of posting. Available from: email address [Accessed date].

e.g. NHS (2012) *Mobile phone safety.* [Online] NHS. Available from: http://www.nhs.co.uk/conditions/Mobile-phone-safety/Pages/Introduction.aspx [Accessed 08/08/12].

e.g. PATIENT.CO.UK (n.d.) *Hypothyroidism – underactive thyroid* [Online] Patient.co.uk. Available from: http://www.patient.co.uk/health/Hypothyroidism-Underactive-Thyroid.htm [Accessed 08/08/12].

e.g. ELECTRONIC ARTS (2003) *The Sims.* [CD] PlayStation 2. London: Electronic Arts Inc.

e.g. SPSS (2004) *SPSS for Windows.* [Software] Version 12.0.1. Chicago: SPSS.

e.g. BROWN, F. (2007) How to promote online reading. [Online] *Library and information professionals discussion list,* 12th May. Available from: http://www.jiscmail.ac.uk/lists/LISprofession. html [Accessed 08/07/14].

Weblogs (Blogs)

AUTHOR (Year) Title of the posting (if applicable). [Weblog] *Title of the site.* Day/month of posting. Available from: web address [Accessed date].

Wikis

WIKI NAME (Year) *Title of article.* [Online] Available from: web address [Accessed date].

Social networking sites (Facebook, Twitter, Bebo etc)

These are web pages so should be referenced as such.

AUTHOR(S) (Year) *Title of page.* [Title of web site] Day/month of posted message. Available from: web address [Accessed date].

Media (video, film, or broadcast)

Title. (Year) [Type of media] ORIGINATOR (e.g. director). Place of production: Production company.

A television or radio broadcast should also include the date and time of broadcast and the episode number, if applicable.

Title (Year) Episode number and name if applicable. [Type of media] **ORIGINATOR** (e.g. channel). Exact date and time of broadcast.

Individual contributors or interviewees should be cited as follows:

e.g. TRANSPORTATION SECURITY ADMINISTRATION (2008) Behaviour detection officers lead to arrest in Orlando. [Weblog] *Evolution of security*. 2nd April. Available from: http://www.tsa.gov/blog/ [Accessed 03/04/08].

e.g. INFOTEACH (2007) *Learning_outcomes*. [Online] Available from: http://infoteach.org/wiki/doku.php/learning_outcomes [Accessed 18/04/13].

e.g. JONES, S. (2009) *Referencing Group*. [Facebook] 5th May. Available from: www.facebook.com [Accessed 09/05/09].

or GUARDIAN (2012) *Homeless teenager forced to live in tent after councils neglect his needs* http://chttp://gu.com/p/39t49/tf. [Twitter] 8th August. Available from: https://twitter.com/guardian/status/232976814790807552 [Accessed 08/08/12].

e.g. *Rebel without a cause*. (1983) [Film] Directed by NICHOLAS RAY. USA: Warner Bros.

e.g. *The culture show*. (2013) [TV] BBC2. 13th March, 2200 hrs.

or *Doctor Who*. (2013) Episode 8, Cold war. [TV] BBC1. 13th April, 1800 hrs.

or *Book of the week*. (2008) The Atlantic Ocean. [Radio] BBC RADIO 4. 21st July, 0945 hrs.

e.g. BROWN, G. (2008) Interview. In: *Today Programme*. [Radio] BBC RADIO 4. 15th May, 0810 hrs.

Online films

Examples include Youtube films.

ORIGINATOR (Year) *Title of film*. [Type of resource] Available from: web address [Accessed date].

Podcasts

BROADCASTER (if available) (Year) *Name of podcast*. [Type of resource i.e. Podcast]

Organisation/publisher responsible (optional). Day of podcast (day, month). Available from: web address [Accessed date].

Online images

ORIGINATOR (Year) *Description or title of image.* [Online image] Available from: web address [Accessed date].

3.5 References – personal communication

A personal communication can be a letter, memo, email, fax, interview, informal conversation, telephone call or lecture presentation. (Some faculties do not permit lecture notes to be included as references.)

They should be included within the text but not in the reference list as the reference is not traceable.

When referencing a personal communication you should:

- Ask permission of the person before quoting them;
- Provide the communicator's initials and surname and the type of communication in the text;
- Provide the exact date of the communication.

Lecture notes on Blackboard

NAME (Year of presentation) *Lecture title*, from MODULE CODE Title of module. Teaching organisation, location and date of presentation. Available from: Blackboard [Accessed date].

e.g. PROQUESTREFWORKS (2012) *1.2 Adding references to Refworks using direct export.* .

[Online film] Available from: http://www.youtube.com/watch?v=0CzBU5rTzGY [Accessed 17/07/13].

e.g. HOPKIN, K. (2008) *The mythical daily water requirement.* [Podcast] Scientific American. 2nd April. Available from: http://www.sciam.com/podcast/episode.cfm?id=0BD1CF72-E411-2EE5-A4CDEE3447E81C93 [Accessed 19/06/13].

e.g. JSCREATIONZS (2012) *Gears concept.* [Online image] Available from:

www.freedigitalphotos.net/images/search.php?searc [Accessed 19/06/13].

e.g. In an email on 23rd July 2014 J. Brown stated that...

or In a conversation on 25th March 2013 B. Jones confirmed that...

or In a lecture on 8th January 2014 V. Rolfe outlined...

3.6 References - reference works

Dictionaries/encyclopaedias

If an encyclopaedia entry has a named author the format for a chapter in a book should be used with the addition of the encyclopaedia volume number.

AUTHOR(S) (Year) Title of chapter. In: AUTHOR(S)/EDITOR(S) (ed./eds.) *Title,* Volume (if applicable). Edition. Place of publication: Publisher, Pages. (use p. or pp.)

If there is no author then the title (e.g. Oxford English dictionary) should be used both within the text and in the reference list.

Title. (Year) Volume (if applicable). Edition. Place of publication: Publisher.

Note: If you are referencing from an online source use the standard referencing format for reference works as detailed above.

Classical works

Principal classical works such as the Bible and Koran/Qur'an should only be included in the text and not in the reference list. Appropriate details should be included but not the year.

APA Reference System

Book with Single Author:
Gore, A. (2006). *An inconvenient truth: The planetary emergency of global warming and what we can do about it.* Emmaus, PA: Rodale.
In-text reference: (Gore, 2006)

Book with Two Authors:
Michaels, P. J., & Balling, R. C., Jr. (2000). *The satanic gases: Clearing the air about global warming.* Washington, DC: Cato Institute.
In-text reference: (Michaels & Balling, 2000)

Book with Editor as Author:
Galley. K. E. (Ed.). (2004). *Global climate change and wildlife in North America.* Bethesda, MD: Wildlife Society.
In-text reference: (Galley, 2004)

Brochure or Pamphlet:
New York State Department of Health. (2002). *After a sexual assault.* [Brochure]. Albany, NY: Author.
In-text reference: (New York, 2002)

An Anonymous Book:
Environmental resource handbook. (2001). Millerton, NY: Grey House.
In-text reference: (Environmental Resource Handbook, 2001)

Articles in Reference Books (unsigned and signed):
Greenhouse effect. (2005). *American heritage science dictionary.* Boston, MA: Houghton Mifflin.
Schneider, S. H. (2000). Greenhouse effect. *World book encyclopedia* (Millennium ed.
Vol. 8, pp. 382-383). Chicago, IL: World Book.
In-text references: (Greenhouse effect, 2005)
(Schneider, 2000)

Magazine Articles:

Allen, L. (2004, August). Will Tuvalu disappear beneath the sea? Global warming threatens to
swamp a small island nation. *Smithsonian, 35*(5), 44-52.
Begley, S., & Murr, A. (2007, July 2). Which of these is not causing global warming? A. Sport
utility vehicles; B. Rice fields; C. Increased solar output. *Newsweek, 150*(2), 48-50.
In-text references: (Allen, 2004)
(Begley, 2007)

Newspaper Articles (unsigned and signed):
College officials agree to cut greenhouse gases. (2007, June 13). *Albany Times Union,* p. A4.
Landler, M. (2007, June 2). Bush's Greenhouse Gas Plan Throws Europe Off Guard.
New York Times, p. A7.
In-text references: ("College Officials", 2007)
(Landler, 2007)

Journal Article with Continuous Paging:
Miller-Rushing, A. J., Primack, R. B., Primack, D., & Mukunda, S. (2006). Photographs and herbarium specimens as tools to document phonological changes in response to global warming. *American Journal of Botany, 93,* 1667-1674.
In-text reference: (Miller-Rushing, Primack, Primack, & Mukunda, 2006)
Journal Article when each issue begins with p.1:
Bogdonoff, S., & Rubin, J. (2007). The regional greenhouse gas initiative: Taking action in Maine. *Environment, 49*(2), 9-16.
In-text reference: (Bogdonoff & Rubin, 2007)

Journal Article from a Library Subscription Service Database with a DOI (digital object identifier):
Mora, C., & Maya, M. F. (2006). Effect of the rate of temperature increase of the dynamic method on the heat tolerance of fishes. *Journal of Thermal Biology, 31,* 337-341. doi: 10.101b/jtherbio.2006.01.055

In-text reference: (Mora & Maya, 2006)

Website:

United States Environmental Protection Agency. (2007, May 4). *Climate Change*. Retrieved From the Environmental Protection Agency website: http://www.epa.gov/climatechange

In-text reference: (United States Environmental, 2007)

Gelspan, R. (2007). *The Heat Is Online*. Lake Oswego, OR: Green House Network. Retrieved from The Heat Is Online website: http://www.heatisonline.org

In-text reference: (Gelspan, 2007)

Chicago Reference Style

The Chicago Manual of Style (CMS) is used mostly in the humanities and allows *either* author-date citations *or* footnotes/endnotes. Such notes can include comments as well as the bibliographic details of the item cited. There should also be a bibliography listing authors in alphabetical order at the end of the text. Insert the note number automatically as superscript after the relevant word in the sentence by pressing Control+Alt+f in MSWord. If there is punctuation, insert it after the punctuation, except for dashes, which are preceded. Footnote numbers should start again for each chapter but endnote numbers run throughout the document.

Book with one author

In-text citation-(Doniger 1999)
Reference-Doniger, Wendy. 1999. *Splitting the difference.* Chicago: University of Chicago Press.

Book with two authors
In-text citation-(Cowlishaw and Dunbar 2000)
Reference-Cowlishaw, Guy, and Robin Dunbar. 2000. *Primate conservation biology.* Chicago: University of Chicago Press.

Book with more than three authors
In-text citation-(Laumann et al. 1994)
Reference-Laumann, Edward O., John H. Gagnon, Robert T. Michael, and Stuart Michaels. 1994. *The social organization of sexuality: Sexual practices in the United States.* Chicago: University of Chicago Press.

Editor, translator, or compiler
In-text citation-(Lattimore 1951)
Reference-Lattimore, Richmond, trans. 1951. *The Iliad of Homer.* Chicago: University of Chicago Press.

Chapter or other part of a book
In-text citation-(Twaddell 1957, 85-87)

Reference-Twaddell, W. Freeman. 1957. A note on Old High German umlaut. In *Readings in linguistics I: The development of descriptive linguistics in America, 1925-1956.* 4th ed. Edited by Martin Joos. Chicago: University of Chicago Press.

Secondary source ("quoted in...")
In-text citation-(Zukofsky 1931)
Reference-Zukofsky, L. 1931. Sincerity and objectification. *Poetry 37* (February 1931): 269. Quoted in B. Costello, *Marianne Moore: Imaginary possessions.* Cambridge, MA: Harvard Univ. Press.

Organization as author
In-text citation-(British Standards Institute 1985)
Reference-British Standards Institute. 1985. *Specifications for abbreviations of title words and titles of publications.* Linford Woods, Milton Keynes, UK: British Standards Institute.

Journal article
In-text citation-(Smith 1998, 639-40)
Reference-Smith, John Maynard. 1998. The origin of altruism. *Nature* 393:639-40.

Magazine article
In-text citation-(Gourmet 2000)
Reference-*Gourmet.* 2000. Kitchen Notebook. May.

Public documents
In-text citation-(Illinois Constitution)
Reference-Illinois Constitution, art. 2, sec. 2. http://www.legis.state.il.us/commission/lrb/conmain.htm.

Online journals
In-text citation-(Warr and Ellison 2000, under "The Consequences of Fear")
Reference-Warr, M., and C.G. Ellison. 2000. "Rethinking Social Reactions to Crime: Personal and Altruistic Fear in Family Households." *American Journal of Sociology* 106, no. 3 (November): 551-78.

[redacted]/AJS/Journal/issues/v106n3/051

[redacted] et al. 2002)

[redacted]-Hlatky, Mark A., Derek Boothroyd, Eric Vittinghoff, Penny Sharp, and Mary A. Whooley. 2002. "Quality-of-Life and Depressive Symptoms in Postmenopausal Women after Receiving Hormone Therapy: Results from the Heart and Estrogen/Progestin Replacement Study (HERS) trial." *Journal of the American Medical Association* 287, no. 5 (February 6), http://jama.ama-assn.org/issues/v287n5/rfull/joc10108.html#aainfo (accessed January 7, 2002).

Organization web site In-text citation-(Federation of American Scientists)

Reference-Federation of American Scientists. Resolution comparison: Reading license plates and headlines. http://www.fas.org/irp/imint/resolve5.htm.

News and journal databases

In-text citation-(Thomas 1956)

Reference-Thomas, Trevor M. 1956. "Wales: Land of Mines and Quarries." *Geographical Review* 46, no.1:59-81. http://www.jstor.org/.

ASA (American Sociological Association) Style Guide

This guide provides examples of citations you might use in research papers following the ASA standard. Explanations and formats are based on the ASA Style Guide, 2nd edition, HM73 .A54 1997 Ref., which is located at the reference desk at Bertrand Library.

Reference List

The reference list appears at the end of the paper and includes only works actually cited in the text. It is arranged alphabetically according to the first element or component in each citation (usually by first author's last name).

ASA reference lists use the usual reverse-indentation system. After the first line of the citation, all subsequent lines are indented 5 spaces. Reference lists are also double-spaced.

ASA style uses the standard headline-style capitalization for titles in the reference list. You capitalize all first and last words in the title and all the other words except articles, prepositions and coordinating words.

Sample Entries: the Basics

• Books (one author, two authors, three or more authors)

Pallant, Julie. 2001. SPSS Survival Manual. Philadelphia: Open University Press.

MacGaw, Dickinson and George Watson. 1976. Political and Social Inquiry. New York: John Wiley & Sons.

Bulcroft, Kris, Linda Smeins, and Richard Bulcroft. 1999.Romancing the Honeymoon: Consummating Marriage in Modern Society. Thousand Oaks, CA: Sage Publications.

• Books (author with an editor, compiler, translator)

Pound, Ezra. 1953. Literary Essays. Edited by T.S. Eliot. New York: New Directions.

Beer, Edith Hahn with Susan Dworkin. 1999. The Nazi Officer's Wife: How One Jewish Woman Survived the Holocaust. New York: HarperCollins Publishers.

ABUSE-LIABLE Pharmacological substances that have the potential for creating abusive dependency. Abuse-liable substances can include both illicit drugs (*e.g.*, heroine) and licit drugs (*e.g.*, methamphetamines).

ADAMHA Alcohol, Drug Abuse, and Mental Health Administration; reorganized in October 1992 as the Substance Abuse and Mental Health Services Administration (SAMHSA). ADAMHA included the National Institute of Mental Health (NIMH), the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Institute on Drug Abuse (NIDA), the Office for Substance Abuse Prevention (OSAP), and the Office for Treatment Intervention (OTI). NIMH, NIAAA, and NIDA are now part of the National Institutes of Health (NIH). (*See also: SAMHSA.*)

ADJUVANT THERAPY Therapy provided to enhance the effect of an primary therapy; auxiliary therapy.

ADVERSE EFFECT An undesirable and unintended, although not necessarily unexpected, result of therapy or other intervention (*e.g.*, headache following spinal tap or intestinal bleeding associated with aspirin therapy).

ASSENT Agreement by an individual not competent to give legally valid informed consent (*e.g.*, a child or cognitively impaired person) to participate in research.

ASSURANCE A formal written, binding commitment that is submitted to a federal agency in which an institution promises to comply with applicable regulations governing research with human subjects and stipulates the procedures through which compliance will be achieved.

AUTHORIZED INSTITUTIONAL OFFICIAL An officer of an institution with the authority to speak for and legally commit the

institution to adherence to the requirements of the federal regulations regarding the involvement of human subjects in biomedical and behavioural research.

AUTONOMY Personal capacity to consider alternatives, make choices, and act without undue influence or interference of others.

AUTOPSY Examination by dissection of the body of an individual to determine cause of death and other medically relevant facts.

BELMONT REPORT A statement of basic ethical principles governing research involving human subjects issued by the National Commission for the Protection of Human Subjects in 1978.

BENEFICENCE An ethical principle discussed in the Belmont Report that entails an obligation to protect persons from harm. The principle of beneficence can be expressed in two general rules: (1) do not harm; and (2) protect from harm by maximizing possible benefits and minimizing possible risks of harm.

BENEFIT A valued or desired outcome; an advantage.

BIOLOGIC Any therapeutic serum, toxin, anti-toxin, or analogous microbial product applicable to the prevention, treatment, or cure of diseases or injuries.

BLIND STUDY DESIGNS *See: Masked Study Designs; Double-Masked Design; and Single-Masked Design.*

CADAVER The body of a deceased person.

CASE-CONTROL STUDY A study comparing persons with a given condition or disease (the cases) and persons without the condition or disease (the controls) with respect to antecedent factors. (*See also: Retrospective Studies.*)

CAT SCAN Abbreviation for Computerized Axial Tomography, an X-ray technique for producing images of internal bodily structures through the assistance of a computer.

CHILDREN Persons who have not attained the legal age for consent to treatment or procedures involved in the research, as determined under the applicable law of the jurisdiction in which the research will be conducted.

CDC Centre for Disease Control and Prevention; an agency within the Public Health Service, Department of Health and Human Services.

CLASS I, II, III DEVICES Classification by the Food and Drug Administration of medical devices according to potential risks or hazards.

CLINICAL TRIAL A controlled study involving human subjects, designed to evaluate prospectively the safety and effectiveness of new drugs or devices or of behavioural interventions.

COGNITIVELY IMPAIRED Having either a psychiatric disorder (*e.g.*, psychosis, neurosis, personality or behaviour disorders, or dementia) or a developmental disorder (*e.g.*, mental retardation) that affects cognitive or emotional functions to the extent that capacity for judgment and reasoning is significantly diminished. Others, including persons under the influence of or dependent on drugs or alcohol, those suffering from degenerative diseases affecting the brain, terminally ill patients, and persons with severely disabling physical handicaps, may also be compromised in their ability to make decisions in their best interests.

COHORT A group of subjects initially identified as having one or more characteristics in common who are followed over time. In social science research, this term may refer to any group of persons who are born at about the same time and share common historical or cultural experiences.

COMPENSATION Payment or medical care provided to subjects injured in research; does not refer to payment (remuneration) for participation in research. (*Compare: Remuneration.*)

COMPETENCE Technically, a legal term, used to denote capacity to act on one's own behalf; the ability to understand information presented, to appreciate the consequences of acting (or not acting) on that information, and to make a choice. (*See also: Incompetence, Incapacity.*)

CONFIDENTIALITY Pertains to the treatment of information that an individual has disclosed in a relationship of trust and with the expectation that it will not be divulged to others without permission in ways that are inconsistent with the understanding of the original disclosure.

CONSENT *See: Informed Consent.*

CONTRACT An agreement; as used here, an agreement that a specific research activity will be performed at the request, and under the direction, of the agency providing the funds. Research performed under contract is more closely controlled by the agency than research performed under a grant. (*Compare: Grant.*)

CONTROL (SUBJECTS) or **CONTROLS** Subject(s) used for comparison who are not given a treatment under study or who do not have a given condition, background, or risk factor that is the object of study. Control conditions may be concurrent (occurring more or less simultaneously with the condition under study) or historical (preceding the condition under study). When the present condition of subjects is compared with their own condition on a prior regimen or treatment, the study is considered historically controlled.

CONTRAINDICATED Disadvantageous, perhaps dangerous; a treatment that should not be used in certain individuals or

conditions due to risks (*e.g.*, a drug may be contraindicated for pregnant women and persons with high blood pressure).

CORRELATION COEFFICIENT A statistical index of the degree of relationship between two variables. Values of correlation coefficients range from -1.00 through zero to +1.00. A correlation coefficient of 0.00 indicates no relationship between the variables. Correlations approaching -1.00 or +1.00 indicate strong relationships between the variables. However, causal inferences about the relationship between two variables can never be made on the basis of correlation coefficients, no matter how strong a relationship is indicated.

CROSS-OVER DESIGN A type of clinical trial in which each subject experiences, at different times, both the experimental and control therapy. For example, half of the subjects might be randomly assigned first to the control group and then to the experimental intervention, while the other half would have the sequence reversed.

DATA AND SAFETY MONITORING BOARD A committee of scientists, physicians, statisticians, and others that collects and analyzes data during the course of a clinical trial to monitor for adverse effects and other trends (such as an indication that one treatment is significantly better than another, particularly when one arm of the trial involves a placebo control) that would warrant modification or termination of the trial or notification of subjects about new information that might affect their willingness to continue in the trial.

DEAD FETUS An expelled or delivered foetus that exhibits no heartbeat, spontaneous respiratory activity, spontaneous movement of voluntary muscles, or pulsation of the umbilical cord (if still attached. Generally, some organs, tissues, and cells (referred to collectively as foetal tissue) remain alive for varying periods of time after the total organism is dead.

DEBRIEFING Giving subjects previously undisclosed information about the research project following completion of their participation in research. (Note that this usage, which occurs within the behavioural sciences, departs from Standard English, in which debriefing is obtaining rather than imparting information.)

DECLARATION OF HELSINKI A code of ethics for clinical research approved by the World Medical Association in 1964 and widely adopted by medical associations in various countries. It was revised in 1975 and 1989.

DEPENDENT VARIABLES The outcomes that are measured in an experiment. Dependent variables are expected to change as a result of an experimental manipulation of the independent variable(s).

DESCRIPTIVE STUDY Any study that is not truly experimental (*e.g.*, quasi-experimental studies, correlational studies, record reviews, case histories, and observational studies).

DEVICE (MEDICAL) *See: Medical Device.*

DHEW A federal agency: U.S. Department of Health, Education and Welfare; reorganized in 1980 as the Department of Health and Human Services (DHHS) and the Department of Education.

DHHS A federal agency: U.S. Department of Health and Human Services; formerly the Department of Health, Education and Welfare (DHEW).

DIAGNOSTIC (PROCEDURE) Tests used to identify a disorder or disease in a living person.

DOUBLE-MASKED DESIGN A study design in which neither the investigators nor the subjects know the treatment group assignments of individual subjects. Sometimes referred to as "double-blind."

DRUG Any chemical compound that may be used on or administered to humans as an aid in the diagnosis, treatment, cure, mitigation, or prevention of disease or other abnormal conditions.

EMANCIPATED MINOR A legal status conferred upon persons who have not yet attained the age of legal competency as defined by state law (for such purposes as consenting to medical care), but who are entitled to treatment as if they had by virtue of assuming adult responsibilities such as being self-supporting and not living at home, marriage, or procreation. (*See also: Mature Minor.*)

EMBRYO Early stages of a developing organism, broadly used to refer to stages immediately following fertilization of an egg through implantation and very early pregnancy (*i.e.*, from conception to the eighth week of pregnancy). (*See also: Foetus.*)

EPIDEMIOLOGY A scientific discipline that studies the factors determining the causes, frequency, and distribution of diseases in a community or given population.

EQUITABLE Fair or just; used in the context of selection of subjects to indicate that the benefits and burdens of research are fairly distributed.

ETHICS ADVISORY BOARD An interdisciplinary group that advises the Secretary, HHS, on general policy matters and on research proposals (or classes of proposals) that pose ethical problems.

ETHNOGRAPHIC RESEARCH Ethnography is the study of people and their culture. Ethnographic research, also called fieldwork, involves observation of and interaction with the persons or group being studied in the group's own environment, often for long periods of time. (*See also: Fieldwork.*)

EXPANDED AVAILABILITY Policy and procedure that permits individuals who have serious or life-threatening diseases for which there are no alternative therapies to have access to investigational

drugs and devices that may be beneficial to them. Examples of expanded availability mechanisms include Treatment INDs, Parallel Track, and open study protocols.

EXPEDITED REVIEW Review of proposed research by the IRB chair or a designated voting member or group of voting members rather than by the entire IRB. Federal rules permit expedited review for certain kinds of research involving no more than minimal risk and for minor changes in approved research.

EXPERIMENTAL Term often used to denote a therapy (drug, device, procedure) that is unproven or not yet scientifically validated with respect to safety and efficacy. A procedure may be considered "experimental" without necessarily being part of a formal study (research) to evaluate its usefulness. (*See also: Research.*)

EXPERIMENTAL STUDY A true experimental study is one in which subjects are randomly assigned to groups that experience carefully controlled interventions manipulated by the experimenter according to a strict logic allowing causal inference about the effects of the interventions under investigation. (*See also: Quasi-Experimental Study*).

FALSE NEGATIVE When a test wrongly shows an effect or condition to be absent (*e.g.*, that a woman is not pregnant when, in fact, she is).

FALSE POSITIVE When a test wrongly shows an effect or condition to be present (*e.g.* that is woman is pregnant when, in fact, she is not).

FDA Food and Drug Administration; an agency of the federal government established by Congress in 1912 and presently part of the Department of Health and Human Services.

FEDERAL POLICY (THE) The federal policy that provides regulations for the involvement of human subjects in research. The Policy applies to all research involving human subjects conducted

supported, or otherwise subject to regulation by any federal department or agency that takes appropriate administrative action to make the Policy applicable to such research. Currently, sixteen federal agencies have adopted the Federal Policy. (Also known as the "Common Rule.")

FETAL MATERIAL The placenta, amniotic fluid, fetal membranes, and umbilical cord.

FETUS The product of conception from the time of implantation until delivery. If the delivered or expelled foetus is viable, it is designated an infant [45 CFR 46.203(c)]. The term "foetus" generally refers to later phases of development; the term "embryo" is usually used for earlier phases of development. (*See also: Embryo.*)

FIELDWORK Behavioural, social, or anthropological research involving the study of persons or groups in their own environment and without manipulation for research purposes (distinguished from laboratory or controlled settings). (*See also: Ethnographic Research.*)

510(K) DEVICE A medical device that is considered substantially equivalent to a device that was or is being legally marketed. A sponsor planning to market such a device must submit notification to the FDA 90 days in advance of placing the device on the market. If the FDA concurs with the sponsor, the device may then be marketed. 510(k) is the section of the Food, Drug and Cosmetic Act that describes premarket notification; hence the designation "510(k) device."

FULL BOARD REVIEW Review of proposed research at a convened meeting at which a majority of the membership of the IRB are present, including at least one member whose primary concerns are in non-scientific areas. For the research to be approved, it must receive the approval of a majority of those members present at the meeting.

GENE THERAPY The treatment of genetic disease accomplished by altering the genetic structure of either somatic (nonreproductive) or germline (reproductive) cells.

GENERAL ASSURANCE Obsolete term, previously used to denote an institutional assurance covering multiple research projects. (*See also: Assurance.*)

GENERAL CONTROLS Certain FDA statutory provisions designed to control the safety of marketed drugs and devices. The general controls include provisions on adulteration, misbranding, banned devices, good manufacturing practices, notification and record keeping, and other sections of the Medical Device Amendments to the Food, Drug and Cosmetic Act [21 U.S. Code §360(c) (Food, Drug and Cosmetic Act §513)].

GENETIC SCREENING Tests to identify persons who have an inherited predisposition to a certain phenotype or who are at risk of producing offspring with inherited diseases or disorders.

GENOTYPE The genetic constitution of an individual.

GRANT Financial support provided for research study designed and proposed by the principal investigator(s). The granting agency exercises no direct control over the conduct of approved research supported by a grant. (*Compare: Contract.*)

GUARDIAN An individual who is authorized under applicable state or local law to give permission on behalf of a child to general medical care.

HELSINKI DECLARATION *See: Declaration of Helsinki.*

HISTORICAL CONTROLS Control subjects (followed at some time in the past or for whom data are available through records) who are used for comparison with subjects being treated concurrently. The study is considered historically controlled when the present

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Fundamentals of Research [illegible] olistic Guide for Research Completion, Management, [illegible] ation and Ethics is a rich conceptual, comprehensive and practical text to accompany researchers in their endeavor. It is a resource book for beginners and experts in research across health, social, natural and applied sciences. This text is aimed to fully expose research methodology from a broader prospective to accompany its readers not only to the completion of research, but furthermore, to its management and continuity. Hence, the rich content of this text consist of ideas and information on research with examples and summary questions as a guide in the following aspects;

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