CSC 4211 RESEARCH METHO IN COMPUTER SCIENCE

Research is a very general term for an activity that involves finding out, in a more or less systematic way, things you did not know. A more academic interpretation is that research involves finding out about things that no-one else knew either. It is about advancing the frontiers of knowledge. Research methods are the techniques you use to do research. They represent the tools of the trade, and provide you with ways to collect, sort and analyse information so that you can come to some conclusions. If you use the right sort of methods for your particular type of research, then you should be able to convince other people that your conclusions have some validity, and that the new knowledge you have created is soundly based.

What Is Empirical Research? Definition, Types & Samples:

How was the world formed? Are there parallel universes? Why does time move forward but never in reverse? These are longstanding questions that have yet to receive definitive answers up to now. In research, these are called empirical questions, which ask about how the world is, how the world works, etc. Such questions are addressed by a corresponding type of study—called empirical research or the empirical method—which is concerned with actual events and phenomena.

What is an empirical study? Research is empirical if it seeks to find a general story or explanation, one that applies to various cases and across time. The empirical approach functions to create new knowledge about the way the world actually works. Let's discusses the empirical research definition, concepts, types, processes, and other important aspects of this method. It also tackles the importance of identifying evidence in research.

I. What is Empirical Research Definition?

A. Definitions

What is empirical evidence? Empirical research is defined as any study whose conclusions are exclusively derived from concrete, verifiable evidence. The

term empirical basically means that it is guided by scientific experimentation or evidence. Likewise, a study is empirical when it uses real-world evidence in investigating its assertions.

This research type is founded on the view that direct observation of phenomena is a proper way to measure reality and generate truth about the world. And by its name, it is a methodology in research that observes the rules of empiricism and uses quantitative and qualitative methods for gathering evidence, that is empirical investigation.

For instance, a study is being conducted to determine if working from home helps in reducing stress from highly-demanding jobs. An experiment is conducted using two groups of employees, one working at their homes, the other working at the office. Each group was observed. The outcomes derived from this research will provide empirical evidence if working from home does help reduce stress or not. This also applies to entrepreneurs when they use a small business idea generator instead of manual procedures.

B. Origins: It was the ancient Greek medical practitioners who originated the term empirical (empeirikos which means “experienced") when they began to deviate from the long-observed dogmatic principles to start depending on observed phenomena. Later on, empiricism pertained to a theory of knowledge in philosophy, which follows the belief that knowledge comes from evidence and experience derived particularly using the senses. Empirical research is used to produce knowledge that is based on experience. At present, the word “empirical" pertains to the gathering of data using evidence that is derived through experience or observation or by using calibrated scientific tools.

II. Types and Methodologies of Empirical Research

Empirical research is done using either qualitative or quantitative methods.

A. Qualitative research: Qualitative research methods are utilized for gathering non-numerical data. It is used to determine the underlying reasons, views, or meanings from study participants or subjects. Under the qualitative research design, empirical studies had evolved to test the conventional concepts of evidence and truth while still observing the fundamental principles of recognizing the subject’s being studied as empirical.

This method can be semi-structured or unstructured. Results from this research type are more descriptive than predictive. It allows the researcher to write a conclusion to support the hypothesis or theory being examined.

Due to realities like time and resources, the sample size of qualitative research is typically small. It is designed to offer in-depth information or more insight regarding the problem. Some of the most popular forms of methods are interviews, experiments, and focus groups.

B. Quantitative research: Quantitative research methods are used for gathering information via numerical data. This type is used to measure behavior, personal views, preferences, and other variables. Quantitative studies are in a more structured format, while the variables used are predetermined.

Data gathered from quantitative studies is analyzed to address the empirical questions. Some of the commonly used quantitative methods are polls, surveys, and longitudinal or cohort studies.

There are situations when using a single research method is not enough to adequately answer the questions being studied. In such cases, a combination of both qualitative and quantitative methods is necessary. Also, papers can also make use of both primary and secondary research methods

III. Qualitative Empirical Research Methods:

Some research question examples need to be gathered and analyzed qualitatively or quantitatively, depending on the nature of the study. These not only supply answers to empirical questions but also outline one's scope of work.

Here are the general types of qualitative research methods:

Observational Method:

This involves observing and gathering data from study subjects. As a qualitative approach, observation is quite personal and time-intensive. It is often used in ethnographic studies to obtain empirical evidence.

The observational method is a part of the ethnographic research design, e.g., archival research, survey, etc. However, while it is commonly used for qualitative purposes, observation is also utilized for quantitative research, such as when observing measurable variables like weight, age, scale, etc.

One remarkable observational research was conducted by Abbott et al. (2016), a team of physicists from the Advanced Laser Interferometer Gravitational-Wave Observatory who examined the very first direct observation of gravitational waves. According to Google Scholar's (2019) Metrics ranking, this study is among the most highly cited articles from the world's most influential journals (Crew, 2019).

Interview method:

This method is exclusively qualitative and is one of the most widely used. Its popularity is mainly due to its ability to allow researchers to obtain precise, relevant information if the correct questions are asked. This method is a form of a conversational approach, where in-depth data can be obtained. Interviews are commonly used in the social sciences and humanities, such as for interviewing resource persons.

Case Study:

This method is used to identify extensive information through an in-depth analysis of existing cases. It is typically used to obtain empirical evidence for investigating problems or business studies. When conducting case studies, the researcher must carefully perform the empirical analysis, ensuring the variables and parameters in the current case are similar to the case being examined. From the findings of a case study, conclusions can be deduced about the topic being investigated.
Case studies are commonly used in studying the experience of organizations, groups of persons, geographic locations, etc.

Textual Analysis:

This primarily involves the process of describing, interpreting, and understanding textual content. It typically seeks to connect the text to a broader artistic, cultural, political, or social context. A relatively new research method, textual analysis is often used nowadays to elaborate on the trends and patterns

of media content, especially social media. Data obtained from this approach are primarily used to determine customer buying habits and preferences for product development, and designing marketing campaigns.

Focus Groups:

A focus group is a thoroughly planned discussion guided by a moderator and conducted to derive opinions on a designated topic. Essentially a group interview or collective conversation, this method offers a notably meaningful approach to think through particular issues or concerns.

This research method is used when a researcher wants to know the answers to “how," “what," and “why" questions. Nowadays, focus groups are among the most widely used methods by consumer product producers for designing and improving products that people prefer.

IV. Quantitative Empirical Research Methods:

Quantitative methods primarily help researchers to better analyze the gathered evidence. Here are the most common types of quantitative research techniques:

Experiment:
A research hypothesis is commonly tested using an experiment, which involves the creation of a controlled environment where the variables are maneuvered. Aside from determining the cause and effect, this method helps in knowing testing outcomes, such as when altering or removing variables. Traditionally, experimental, laboratory-based research is used to advance knowledge in the physical and life sciences, including psychology. In recent decades, more and more social scientists are also adopting lab experiments.

Survey:
Survey research is designed to generate statistical data about a target audience. Surveys can involve large, medium, or small populations and can either be a one-time event or a continuing process. Governments across the world are among the heavy users of continuing surveys, such as for census of populations or labor force surveys. This is a quantitative method that uses predetermined sets of closed questions that are easy to answer, thus enabling the gathering and analysis of large data sets.

In the past, surveys used to be expensive and time-consuming. But with the advancement in technology, new survey tools like social media and emails have made this research method easier and cheaper.

Causal-Comparative research:

This method leverages the strength of comparison. It is primarily utilized to determine the cause and effect relationship among variables. For instance, a causal-comparative study measured the productivity of employees in an organization that allows remote work setup and compared that to the staff of another organization that does not offer work from home arrangements.

Cross-sectional research:

While the observation method considers study subjects at a given point in time, cross-sectional research focuses on the similarity in all variables except the one being studied.
This type does not allow for the determination of cause-effect relationships since subjects are now observed continuously. A cross-sectional study is often followed by longitudinal research to determine the precise causes. It is used mainly by pharmaceutical firms and retailers.

Longitudinal study:

A longitudinal method of research is used for understanding the traits or behavior of a subject under observation after repeatedly testing the subject over a certain period of time. Data collected using this method can be qualitative or quantitative in nature.

A commonly-used form of longitudinal research is the cohort study. For instance, in 1951, a cohort study called the British Doctors Study (Doll et al., 2004) was initiated, which compared smokers and non-smokers in the UK. The study continued through 2001. As early as 1956, the study gave undeniable proof of the direct link between smoking and the incidence of lung cancer.

Correlational research:

This method is used to determine the relationships and prevalence among variables. It commonly employs regression as the statistical treatment for predicting the study's outcomes, which can only be a negative, neutral, or positive correlation.

A classic example of empirical research with correlational research is when studying if high education helps in obtaining better-paying jobs. If outcomes indicate that higher education does allow individuals to have high-salaried jobs, then it follows that people with less education tend to have lower-paying jobs.

Steps for Conducting Empirical Research:

Since empirical research is based on observation and capturing experiences, it is important to plan the steps to conduct the experiment and how to analyze it. This will enable the researcher to resolve problems or obstacles, which can occur during the experiment.

1: Establishing the research objectives:

In this initial step, the researcher must be clear about what he or she precisely wants to do in the study. You should frame the problem statement, plans of action, and determine any potential issues with the available resources, schedule, etc. for the research.

Most importantly, the researcher must be able to ascertain whether the study will be more beneficial than the cost it will incur.

2: Reviewing relevant literature and supporting theories:

The researcher must determine relevant theories or models to his or her research problem. If there are any such theories or models, they must understand how it can help in supporting the study outcomes. Relevant literature must also be consulted. The researcher must be able to identify previous studies that examined similar problems or subjects, as well as determine the issues encountered.

3: Framing the hypothesis and measurement:

The researcher must frame an initial hypothesis or educated guess that could be the likely outcome. Variables must be established, along with the research context.
Units of measurements should also be defined, including the allowable margin of errors. The researcher must determine if the selected measures will be accepted by other scholars.

4: Defining the research design, methodology, and data collection techniques:

Before proceeding with the study, the researcher must establish an appropriate approach for the research. He or she must organize experiments to gather data that will allow him or her to frame the hypothesis. The researcher should also decide whether he or she will use a non-experimental or experimental technique to perform the study. Likewise, the type of research design will depend on the type of study being conducted.

Finally, the researcher must determine the parameters that will influence the validity of the research design. Data gathering must be performed by selecting suitable samples based on the research question. After gathering the empirical data, the analysis follows.

5: Conducting data analysis and framing the results

Data analysis is done either quantitatively or qualitatively. Depending on the nature of the study, the researcher must determine which method of data analysis is the appropriate one, or whether a combination of the two is suitable. The outcomes of this step determine if the hypothesis is supported or rejected. This is why data analysis is considered as one of the most crucial steps in any research undertaking.

6: Making conclusions

A report must be prepared in that it presents the findings and the entire research proceeding. If the researcher intends to disseminate his or her findings to a wider audience, the report will be converted into an article for publication. Aside from including the typical parts from the introduction and literature view, up to the methods, analysis, and conclusions, the researcher should also make recommendations for further research on his or her topic.

To ensure the originality and credibility of the report or research, it is essential to employ a plagiarism checker. By using a reliable plagiarism checker, the researcher can verify the uniqueness of their work and avoid any unintentional instances of plagiarism. This step helps maintain the integrity of the research and ensures that the recommendations for further research are based on the researcher’s own original insights. Incorporating a plagiarism checker into the writing process provides an additional layer of assurance and professionalism, enhancing the impact of the report or article in the academic community.

Educators can also check the originality of their students' research by utilizing a free plagiarism checker for teachers.

VI. Empirical Research Cycle:

The empirical research cycle is composed of five phases, with each one considered as important as the next phase (de Groot, 1969). This rigorous and systematic method can consistently capture the process of framing hypotheses on how certain subjects behave or function and then testing them versus empirical data. It is considered to typify the deductive approach to science.

These are the five phases of the empirical research cycle:

1. Observation:

   During this initial phase, an idea is triggered for presenting a hypothesis. It involves the use of observation to gather empirical data.

2. Induction

   Inductive reasoning is then conducted to frame a general conclusion from the data gathered through observation.

   A researcher may pose the question, "Does the tendency to use a smartphone indicate that today's consumers need to be informed before making purchasing decisions?" The researcher can assume that is the case. Nonetheless, since it is still just a supposition, an experiment must be conducted to support or reject this hypothesis.

   The researcher decided to conduct an online survey to inquire about the buying habits of a certain sample population of buyers at brick-and-mortar stores. This is to determine whether people always look at their smartphones first before making a purchase.

3. Deduction

   This phase enables the researcher to figure out a conclusion out of the experiment. This must be based on rationality and logic in order to arrive at particular, unbiased outcomes. For example:

4. Testing

This phase involves the researcher going back to the empirical research steps to test the hypothesis. There is now the need to analyze and validate the data using appropriate statistical methods.

5. Evaluation

This phase is often neglected by many but is actually a crucial step to help keep expanding knowledge. During this stage, the researcher presents the gathered data, the supporting contention/s, and conclusions.

The researcher likewise puts forth the limitations of the study and his hypothesis. In addition, the researcher makes recommendations for further studies on the same topic with expanded variables.

HOW TO WRITE A RESEARCH PROPOSAL?

Most students and beginning researchers do not fully understand what a research proposal means, nor do they understand its importance. Your research is only as good as one's proposal. An ill-conceived proposal dooms the project even if it somehow gets through the Thesis Supervisory Committee. A high quality proposal, on the other hand, not only promises success for the project, but also impresses your Thesis Committee about your potential as a researcher. A research proposal is intended to convince others that you have a worthwhile research project and that you have the competence and the work-plan to complete it.

Generally, a research proposal should contain all the key elements involved in the research process and include sufficient information for the readers to evaluate the proposed study. Regardless of your research area and the methodology you choose; all research proposals must address the following questions:

What you plan to accomplish,

Why you want to do it and

How you are going to do it.

The proposal should have sufficient information to convince your readers that you have an important research idea, that you have a good grasp of the relevant literature and the major issues, and that your methodology is sound. The quality

of your research proposal depends not only on the quality of your proposed project, but also on the quality of your proposal writing. A good research project may run the risk of rejection simply because the proposal is poorly written. Therefore, it pays if your writing is coherent, clear and compelling.

CHAPTER AND SECTIONS CONSTITUTING A RESEARCH PROJECT

Speaking technically, the research process is a model of the scientific method of thinking or of analyzing problems. As a model of science, the research process in its simplified form will be constituted by the following stages of activities:

Problem identification and definition

Hypothesis or answer(s) formulation

Research design and data collection

Data analysis and discussion

Conclusion and generalization making

In all applied research studies, these basic stages of activities are mechanically followed in the process of investigating problems peculiar to the various specific areas of life. In writing the research report, the impersonal mode is preferred for communication. Instead of stating that “I did this” or “I did that”, you can say “the study was carried out……, the samples are…….,” the research report will depend on the research philosophy and the culture of the institution, organization or the department in control. Different institutions or departments have their own house styles. Before you start writing your research report, find out the house style of your own school.

The arrangement of different parts of the report should make it possible for a reader to easily locate any section of particular interest to him. To give you a guideline, a conventional format for arranging research reports in a particular thesis need not have all the sections therefore; relevant sections would be used in the appropriate order. The format is as follows:

Preliminary pages:

Title page

Acceptance page or approval page

Dedication

Acknowledgement

Abstract

Table of content

List of tables

List of figures

List of appendices

Chapter One- Introduction:

Background to the problem or Rationale for the problem

Statement of the problem

Significance of the study

Objectives of the study or purpose of the study

Scope of the study

Area of study / context of the study

Research questions and or hypothesis

Definition of terms (operational definitions)

Review of literature:

Theoretical and conceptual frame work

Review of related researches

Research Methodology

Research design

Population

Sampling technique and samples

Instrumentation – development and administration of instruments

Data collection

Data analysis techniques

Limitations

Results and discussion

Presentation and analysis of data

Interpretation of the findings

Summary and Conclusion

Summary of results.

General conclusion

Implications of the study and / or recommendations.

Suggestion for further study

Supplementary

Bibliography

Appendix

Index

Let us describe some of these sections

THE PRELIMINARY PAGES

The first page of the report is the title page, where the table of the project is clearly, briefly and to the point stated. The title should contain such essential elements as the major variables and the target population. It should be phrased in such a way that it describes what the study is all about. It should not be phrased in an emotionally laden way in order to suggest that a particular point of view is being sold or emphasized to the reader. Look at this title „Gender differences in Mathematics enrolment among NECO candidate in 2008". You will notice that the title clearly shows the variable is gender and mathematics enrolment while the target population is NECO candidates in 2008. The title page will also show the degree that will be awarded on the successful completion of the research, the awarding institution sometimes the faculty/school, the date of the award, the students name and matriculation number where applicable. In some cases, previous qualifications of the student are stated after the student's name.

The acceptance page: This is laid out in a way specified by the institution to which the research project report is submitted for a degree. This page may contain the

following information: The names, signatures of the departmental head, the dean, the supervisors, the dates, and the name of the students and very importantly an attestation of the originality of the research report. Some institutions also require the name and signature of the external examiner.

The dedication page: This permits emotionally laden words in which tribute is paid to individual or group who are dear to the writer or those who would be interested in the research findings.

The Acknowledgment Page: This page expresses gratitude to all those who helped you in the research process, that is in conducting the research and preparing the report.

Abstract: This succinctly summarizes the research process by stating the aim of the investigation, the population, samples, and methods of investigation, the measuring instruments used and the findings.

The Table of Content: This lays out in a tabular form, the chapters, headings and sub-headings of the report with the page numbers in which various sections of the report may be located. You have to sequentially arrange and number the content from preliminary to supplementary pages.

The List of Tables: This is similar to the table of contents. It shows the page numbers in which the table presented in the report are located. The number and title of each table should be serially listed. Similarly, the list of figures tabulates all figures, their numbers, titles and the pages where they are presented in the report or where they can be located. Again, the list of appendices should also be serially arranged in numerical order.

CHAPTER ONE – The Introduction.

The background to the problem: This presents reasonable statements to indicate that it is valuably worthwhile to spend time, energy, to dissipate resources to carry out this investigation in the problem area. You have to present the reasoning to be clear and convincing to the readers.

The problem statement: Some of the times, this is stated in interrogative or question statements which define and limit the scope and direction of interest of the researcher in his topic of study. It deals with the nature of the topic or issue of study which needs clarification.

The significance of the study: This shows the utility value of the research. The findings of your research are expected to profit some individuals or institutions, etc. These beneficiaries and the benefit expected to accrue to them ought to be mentioned.

The objectives of the study: This should state the specific aspects of the problem investigated in the research and the reasons for focusing on these aspects. This section should give a brief overview of all the elements that would be investigated. Some of the times this section is interchanged with the purpose of the study.

The scope of the study: This indicates the extent to which the researcher intended to cover the topic, the geographical area, time period and variables to be covered. Some of the times, this section is interchanged with delimitation of the study.

The research questions and / or hypotheses: These are stated in order to guide and direct the researcher in the investigation especially in the area of literature review, collection an analysis of data, discussion etc.

The definition of terms: This section is used to educate and inform the reader on the operational meaning of any coined or technical words, phrases or expression which cannot otherwise be understood because of their unconventional usage. You should not include any terms to which appropriate meaning is attached by conventional usage. The essence of definition is to make sure your readers understand the specific meanings you ascribe to the term in your study.

CHAPTER TWO – Literature Review.

In this chapter section, you are expected to show what other researchers and writers have done, said, written, found out in the area of the research topic you are investigating. You are expected to make reviews of theoretical, conceptual and empirical literature. Any literature review should provide guidance on the research hypotheses/questions and problem, the methodology to use for the study and on the anticipated findings of the study.

The theoretical and conceptual literature review will provide theoretical and conceptual information. In other words, it will provide the definitions and meanings of the key concepts and variables in the study and also the theoretical bases for the study while the empirical literature review will provide if possible, a comprehensive account of research findings of other studies related to your own study in order to provide comparative empirical findings upon which to evaluate the new ones to be generated in the study on your hand.

3.5 CHAPTER THREE – Methodology

The research design: In this section, you should make a write up to show the extent to which extraneous variables were controlled or eliminated. You should also report any lapses as limitations. The design may or may not fall into the neat categories of research design described earlier.

Infact, you can use a combination of design if need be. Effective control of extraneous variables may dictate the use of unlabelled designs. Therefore, any plan that you use should be clearly described even if it cannot be classified under a conventional label used in research.

The population: You should make a description of this in order to specify all the necessary parameters to ensure that all the constituents and characteristics of the target population are not ambiguous. You should not take the population as the area of study. For instance, an area of study could be cement company management staff. To enhance the population description, you should tabulate the constituent's elements and their characteristics. For instance, you can take Dangote cement company management staff in Obajana in Kogi state to be managers, accountants, supervisors, board members etc. The cement company could be classified into categories. These could also be classified according to gender. An example using hypothetical tabulations can be given.

PROPOSAL CONTENTS

The research proposal is written before the actual research work is carried out. It tells the reader the type of problem or issue you are intending to study, why and how you intend to carry out the study. It is usually differentiated from the final research report from the language used in writing the proposal. In other words, the language of the future is usually cast in the proposing write up. That is to say that you use such expressions in the language of the future tense.

For instance, the problem of study will be, the researcher shall, the population will compromise, the samples shall be, observation techniques will be used for data collection, the **Chi-Square Statistics** will be used for the data analysis, or the research will use **water fall model** etc. The research proposal is made up of the first three chapters of the orthodox research report. The only difference is in language. So, while the language of the proposal will be in the proposing language of intention cast in the future tense, the final research project report will be in the language of finality or of accomplished actions cast in the past tense. Examples –

The problem of study was, the researcher delimited, delineated, defined, the population of study was, the samples were selected using. etc.

Apart from the three chapters, the research proposals for grants or contracts etc will also include Time Schedule. This gives the time period allocated to each step of activities from the beginning to the end including the submission of the final research project report. For instance: Review of Literature – 6 months, development of instruments – 2 months, Trial testing of the instruments 3 months data collection – 6 months, organization of data – 4 months etc. The Proposal will also contain the budget of estimated expenses for carrying out the main research.

Note that budgets and Time schedules are not added in a proposal meant for your supervisor or defence in the school or faculty. The degree research proposal may also contain supplementary pages where appendices will contain references among others.

The components of a research proposal are

Chapter one – Introduction

Chapter two – Literature review

Chapter three - Methodology

Time schedule

Proposal budget

Supplementary pages (if any)

FORMULATING RESEARCH QUESTIONS:

Developing research questions should be Clear and focused, in other words, the question should clearly state what the writer needs to do. Not too broad and not too narrow. The question should have an appropriate scope. Not too easy to answer, Not too difficult to answer, Researchable, Analytical rather than descriptive. How do you write a research question? Originates from issues raised in the problem statement, Your research questions make the objectives of the study.

What is an example of a research question?

How does students access school portal for courses registration?

How does students create their course portal during registration? etc

A research question is the main question your study seeks to answer. Learn how to write a strong research question.

RESEARCH DESIGNS

There are numerous types of research design that are appropriate for the different types of research projects. The choice of which design to apply depends on the nature of the problems posed by the research aims. Each type of research design has a range of research methods that are commonly used to collect and analyse the type of data that is generated by the investigations. Here is a list of some of the more common research designs, with a short explanation of the characteristics of each.

HISTORICAL

This aims at a systematic and objective evaluation and synthesis of evidence in order to establish facts and draw conclusions about past events. It uses primary historical data, such as archaeological remains as well as documentary sources of the past. It is usually necessary to

carry out tests in order to check the authenticity of these sources. Apart from informing us about what happened in previous times and re-evaluating beliefs about the past, historical research can be used to find contemporary solutions based on the past and to inform present and future trends. It stresses the importance of interactions and their effects.

DESCRIPTIVE

This design relies on observation as a means of collecting data. It attempts to examine situations in order to establish what is the norm, i.e. what can be predicted to happen again under the same circumstances. ‘Observation’ can take many forms. Depending on the type of information sought, people can be interviewed, questionnaires distributed, visual records made, even sounds and smells recorded. Important is that the observations are written down or recorded in some way, in order that they can be subsequently analysed. The scale of the research is influenced by two major factors: the level of complexity of the survey and the scope or extent of the survey.

CORRELATION

This design is used to examine a relationship between two concepts. There are two broad classifications of relational statements: an association between two concepts – where there is some kind of influence of one on the other; and a causal relationship – where one causes changes to occur in the other. Causal statements describe what is sometimes called a 'cause and effect' relationship. The cause is referred to as the 'independent variable', the variable that is affected is referred to as the 'dependent variable'.

The correlation between two concepts can either be none (no correlation); positive (where an increase in one results in the increase in the other, or decrease results in a decrease); or negative (where the increase in one results in the decrease in the other or vice versa). The degree of association is often measurable.

COMPARATIVE

This design is used to compare past and present or different parallel situations, particularly when the researcher has no control over events. It can look at situations at different scales, macro (international, national) or micro (community, individual). Analogy is used to identify similarities

in order to predict results – assuming that if two events are similar in certain characteristics, they could well be similar in others too. In this way comparative design is used to explore and test what conditions were necessary to cause certain events, so that it is possible, for example, to understand the likely effects of making certain decisions.

EXPERIMENTAL

Experimental research attempts to isolate and control every relevant condition which determines the events investigated and then observes the effects when the conditions are manipulated. At its simplest, changes are made to an independent variable and the effects are observed on a dependent variable – i.e. cause and effect. Although experiments can be done to explore a particular event, they usually require a hypothesis (prediction) to be formulated first in order to

determine what variables are to be tested and how they can be controlled and measured. There are several classes of experiment – pre, true, quasi, etc. which are characterized by the amount of checking and control involved in the methods.

SIMULATION

Simulation involves devising a representation in a small and simplified form (model) of a system, which can be manipulated to gauge effects. It is similar to experimental design in the respect of

this manipulation, but it provides a more artificial environment in that it does work with original materials at the same scale. Models can be mathematical (number crunching in a computer) or physical, working with two- or three-dimensional materials. The performance of the model must be checked and calibrated against the real system to check that the results are reliable. Simulation enables theoretical situations to be tested – what if?

EVALUATION

This descriptive type of research is specifically designed to deal with complex social issues. It aims to move beyond 'just getting the facts', by trying to make sense of the myriad human, political, social, cultural and contextual elements involved. There are a range of different approaches of evaluation models, for example, systems analysis – which is a holistic type of research looking at the complex interplay of many variables; and responsive evaluation – which entails a series

of investigative steps to evaluate how responsive a programme is to all those taking part in it. A common purpose of evaluation research is to examine the working of projects from the point of view of levels of awareness, costs and benefits, cost-effectiveness, attainment of objectives and quality assurance. The results are generally used to prescribe changes to improve and develop the situation.

ACTION

Essentially, this is an 'on the spot' procedure, principally designed to deal with a specific problem found in a particular situation. There is no attempt made to separate the problem from its context in order to study it in isolation. What are thought to be useful changes are made and then constant monitoring and evaluation are carried out to see the effects of the changes. The conclusions from the findings are applied immediately, and further monitored to gauge their effectiveness.

Action research depends mainly on observation and behavioural data. Because it is so bound up in a particular situation, it is difficult to generalize the results, i.e. to be confident that the action

will be successful in another context.

ETHNOLOGICAL

Ethnological research focuses on people. In this approach, the researcher is interested in how the subjects of the research interpret their own behaviour rather than imposing a theory from outside. It takes place in the undisturbed natural settings of the subjects' environment. It regards the context to be as equally important as the actions it studies, and attempts to represent the totality of the social, cultural and economic situation. This is not easy as much of culture is hidden and rarely made explicit and the cultural background and assumptions of the researcher may unduly influence the interpretations and descriptions. More-over there can be confusions produced by the use of language and the different meanings which may be given to wordsby the respondents and researcher.

FEMINIST

This is more of a perspective than a research design that involves theory and analysis that highlight the differences between men's and women's lives. Researchers who ignore these differences can come to incorrect conclusions. However, everyone is male or female, so value neutrality is impossible as no researcher practises research outside his or her system of values. No specific methods are seen to be particularly feminist, but the methodology used is informed by theories of gender relations. Although feminist research is undertaken with a political commitment to identify and transform gender relations, it is not uniquely political, but exposes all methods of social research as being political.

CULTURAL

Many of the prevailing theoretical debates (e.g. postmodernism, post structuralism etc.) are concerned with the subjects of language and cultural interpretation. Cultural research provides methodologies that allow a consistent analysis of cultural texts so that they can be compared, replicated, disproved and generalized. Examples of approaches to the interpretation of cultural texts

are: content analysis, semiotics and discourse analysis. The meaning of the term ‘cultural

texts’ has been broadened from that of purely literary works to that of the many different forms of communication, both formal such as opera, TV news programmes, cocktail parties etc., and informal such as how people dress or converse.

DECIDING ON YOUR TYPE OF RESEARCH

It is your research interest that decides the nature of your research problem, and this will indicate the appropriate type of research to follow. Once the objectives of a research project have been established, the issue of how these objectives can be met leads to a consideration of which research design should be chosen. The research design provides a framework for the collection and analysis of data and subsequently indicates which research methods are appropriate. You can combine two or more types of research design, particularly when your subject combines the study of human behaviour with that of, for example, economics, technology, legislation or organizations.

The different types of research design may involve the use of their own specific types of research methods, developed specifically to solve the problems inherent in that design. However, some methods are widely used across many research types.

RESEARCH THEORY

Research is about acquiring knowledge and developing understanding, collecting facts and interpreting them to build up a picture of the world around us, and even within us. It is fairly obvious then, that we should hold a view on what knowledge is and how we can make sense of our surroundings. There are different ways of going about doing research depending on your assumptions about what actually exists in reality and what we can know (metaphysics) and how we can acquire knowledge (epistemology).

METAPHYSICS AND EPISTEMOLOGY

Metaphysics is concerned with questions such as what it is to be, who we are, what is knowledge, what are things, what is time and space. At one extreme there is:

1.Idealism, that advocates that reality is all in the mind, that everything that exists is in some way dependent on the activity of the mind. Hence, as phenomena are reliant on mental and social factors they are therefore in a state of constant change e.g. music is not just sound, it is an emotional experience. and at the other extreme is:

2. Materialism (or reductionism), that insists that only physical things and their interactions exist and that our minds and consciousness are wholly due to the active operation of materials. Hence, phenomena are independent of social factors and are therefore stable e.g. music is just vibrations in the air.

3. Epistemology: is the theory of knowledge, especially about its validation

and the methods used. It deals with how we know things and what we can regard as acceptable knowledge in a discipline. It is concerned with the reliability of our senses and the power of the mind. As for the methods of acquiring knowledge, there are two basic approaches:

1. Empiricism – knowledge gained by sensory experience (using inductive reasoning);

2. Rationalisms – knowledge gained by reasoning (using deductive reasoning). The relative merits of these approaches have been argued ever since the Ancient Greeks – Aristotle advocating the first and Plato the second.

INDUCTIVE AND DEDUCTIVE REASONING

The reasoning behind the empirical and rationalist approaches to gaining knowledge also start from opposite ends of a spectrum. Although it is not possible to apply either extreme in a practical way, it is useful to characterize the distinct differences in the two opposing approaches. A more practical approach that goes a long way to overcome the shortcomings of each is the hypothetico-deductive method, which uses the features of each in a pragmatic way, in fact, the method used in much scientific enquiry and hence also called 'scientific method'.

1. INDUCTIVE REASONING – THE EMPIRICIST'S APPROACH

Inductive reasoning starts from specific observations or sensory experiences and then develops a general conclusion from them. This simple example gives an indication of the line of reasoning:

All the giraffes that I have seen (Repeated observations) have very long necks. Therefore I conclude that all (Conclusion) giraffes have long necks. Induction was the earliest and, even now, the commonest popular form of scientific activity. We use it every day in our normal lives as

we learn from our surroundings and experiences. We come to conclusions from what we have experienced and then generalize from them, that is, set them up as a rule or belief.

2. DEDUCTIVE REASONING – THE RATIONALIST'S APPROACH

Deductive reasoning begins with general statements (premises) and, through logical argument, comes to a specific conclusion. Again, a simple example will provide a guide to how this works:

All living things (General statement – first premise) will eventually die. This animal is a living thing. (Inference – second premise) Therefore, this animal (Conclusion) will eventually die. This is the simplest form of deductive argument, and is call a syllogism.

As you can see it consists of a general statement (called the first premise), The methods of testing are likewise based on assumptions and influenced by surrounding conditions. If the predictions of the theory are not borne out in the results of the tests, it could be the underlying premises which are at fault rather than the theory itself. There are certain assumptions that underlie scientific method that relate to a materialist view of metaphysics and a positivist view of epistemology. These assumptions are:

Order – the universe is an ordered system that can be investigated and the underlying 'rules' can be exposed.

External reality – we all share the same reality that does not depend on our existence. We can therefore all equally contribute to and share knowledge that reflects this reality.

Reliability – we can rely on our senses and reasoning to produce facts that reliably interpret reality.

Parsimony – the simpler the explanation the better. Theories should be refined to the most compact formulation .

Generality – the ‘rules’ of reality discovered through research can be applied in all relevant situations regardless of time and place.

THE RESEARCH PROCESS

It is necessary to first define some kind of research problem in order to provide a reason for doing the research. The problem will generate the subject of the research, its aims and objectives, and will indicate what sort of data need to be collected in order to investigate the issues raised and what kind of analysis is suitable to enable you to come to conclusions that provide answers to the questions raised in the problem. This process is common to virtually all research projects, whatever their size and complexity. And they can be very different. These differences are due to their subject matters; for example compare an investigation into sub-nuclear particles with a study of different teaching methods, differences in scales of time and resources, and extent of pioneering qualities and rigour. Some projects are aimed at testing and refining existing knowledge, others at creating new knowledge. The answers to four important questions underpin the framework

of any research project:

1.What are you going to do? The subject of your research.

2. Why are you going to do it? The reason for this research being

necessary or interesting.

3.How are you going to do it? The research methods that you will

use to carry out the project.

4.When are you going to do it? The programme of the work. The answers to these questions will provide a framework for the

actual doing of the research. The answers to these questions are not simple.

THE RESEARCH PROBLEM

There is no shortage of problems throughout the world, but for a problem to be researchable, it needs to have several crucial features.

1.It must be stated clearly and concisely;

2.significant i.e. not trivial or a repeat of previous work;

3.delineated, in order to limit its scope to practical investigation;

4. possible to obtain the information required to explore the problem;

5. possible to draw conclusions related to the problem, as the point of research is to find some answers.

A research problem can be based on a question, an unresolved controversy, a gap in knowledge or an unrequited need within the chosen subject. An awareness of current issues in the subject and an inquisitive and questioning mind and an ability to express yourself clearly is required in order to find and formulate a problem that is suitable for a research project.

DEFINING THE RESEARCH PROBLEM

Here are several forms in which the research problem can be expressed to indicate the method of investigation. Here are several forms in which the research problem can be expressed to indicate the method of investigation.

QUESTION OR QUESTIONS

Probably the simplest way to set up a research problem is to ask a question. This might be quite abstract in nature, so will require to be broken down into several sub-questions that can be practically investigated. The nice thing about questions is that they demand answers – a good incentive to do some research! Here is an example of a research problem expressed as a main question:

Main question: Are school exam results a true test of a student's intelligence?

Questions can then be used to break the main problem down into questions to the define sub-problems. The different things you can do to split up the main question are to:

Split it down into different aspects that can be investigated separately, e.g. political, economic, cultural, technical.

1.Explore different personal or group perspectives, e.g. employers, employees.

2. Investigate different concepts used, e.g. health, wealth, confidence, sustainability.

3.Consider the question at different scales, e.g. the individual, group, organization.

4. Compare the outcomes of different aspects from the above ways of splitting down.

In this case the sub-questions could concentrate on:

i. What constitutes intelligence? (Investigating a concept, i.e. 'intelligence'.)
ii. What ways of testing intelligence are there? (Exploring different perspectives – i.e. other intelligence tests, and thus investigating the concept 'test'.)
iii. What sort of school exams are there and how are they marked? (Investigating another concept – i.e. 'exams'.)
iv. How do school exam criteria match those of the criteria of other intelligence tests? (Split into aspects – in this case, criteria of exams and other intelligence tests.)

Note how all the sub-questions relate directly to the main question and break down the rather abstract question into practical questions that can be investigated individually and build up to an answer to the main question. For smaller scale studies, an exploratory approach may be used. The subject and scope of the exploration can be expressed in a statement of intent. Again, this must be derived from the research problem, imply a method of approach and indicate the outcome. An example of this form of research definition is:

This study examines the problem of career development of women engineers in the automotive industry in Britain. It focuses on the identification of specific barriers (established conventions, prejudices, procedures, career paths) and explores the effectiveness of specific initiatives that have been aimed at breaking down these barriers.

Note how the problem, in this case of career development, is narrowly delimited in order to put a boundary around the scope of the work, for example only women engineers, only in the automotive industry, and only in Britain. It also lists the practical tasks to be carried out, i.e. identification of specific barriers, and

exploration of initiatives. This list of barriers stipulates in more detail the actual subjects of the investigation.

HYPOTHESES

The research problem in research projects that use the hypothetic deductive method is expressed in terms of the testing of a particular hypothesis.

Hypotheses are nothing unusual; we make them all the time. If something happens in our everyday life, we tend to suggest a reason for its occurrence by making rational guesses. These reasonable guesses can be expressed in the form of statement. This is a hypothesis.

If, on further examination, a particular hypothesis is found to be supported, i.e. the reasons for its occurrence seem to be correct, we have got a good chance that we can predict what will happen in the same situation in the future, or can devise actions to prevent it happening again. If the investigation shows that the guess was wrong, then it can be rejected as false. Many of the greatest discoveries in science were based on hypotheses: Newton's theory of gravity, Einstein's general theory of relativity and a host of others.

A good hypothesis is a very useful aid to organizing the research effort, but it must have certain qualities. It must be a statement that can be put to the test. It must specifically limit the enquiry to the interaction of certain factors (usually called variables) and suggest the methods appropriate for collecting, analysing and interpreting the data, and the resultant confirmation or rejection of the hypothesis through empirical or experimental testing must give a clear indication of the extent of knowledge gained.

THE USE OF ARGUMENT

The whole point of doing a research project is to identify a particular question or problem, to collect information and to present some answers or solutions. In order to convince the reader that you have collected information relevant to the question or problem and that you have based your answers and conclusions on the correct analysis of this information you will need to use some logical argument.

You might want to defend or challenge a particular point of view or propose a new or improved one. You will have to play the part of a detective making a case in court. The detective will set out to solve the problem (who committed the crime and how?) by analysing the situation (the scene and events of the crime, the

possible suspects), collecting and reviewing the evidence, then making a case for his/her conclusions about ‘who-done-it’ and how. The jury will have to decide whether the argument is convincing and that the evidence is sufficiently strong. In the case of a research project, you will be setting the problem and laying out your case, and the reader of your report, dissertation or thesis will be your jury.