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COURSE NAME:

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**1: What is a Scientific Research?**

Scientific research is a systematic and objective process focusing on a multitude of information for analysis to enable the researcher to infer a reasonable conclusion. It is a process that is involved in testing ideas or hypothesis documented for other researchers to replicate the study.

It is the process of arriving at dependable solutions to problems through a planned and systematic collection, analysis, and interpretation of data (Godwill, 2015)

A scientific research process follows eight steps that are interlinked to each other. The steps are as follows:

1. Identify the Problem or develop a research question.
2. Do a literature Review: To find out the studies that have been conducted in the past about this problem.
3. Clarify the problem: This narrows the scope of the study to bring more clarity.
4. Define Terms and Concepts clearly: Key words and phrases used in the study are to be clearly defined.
5. Define the population: The study could examine a specific group of people or people living in a specific geographical location.
6. Develop the instrumentation plan: this plan is the road map for the study, specifying how, when and where data collection will take place.
7. Data Collection: Data collection is at the beginning and at the end of the program. It provides information needed to answer the research question.
8. Data Analysis: Data are analysed according to the instrumentation plan to answer the research question.

**2. Scope of investigation**:

The scope of a research will define the purpose of the research, the population size and characteristics, the geographical location, time and period of research, the theories of the research focus. (Editage Insights, 2019).

Research can be categorized into four, based on the purpose of study. These are:

Exploratory research: This is the type of research done when little or no previous study exists to explain a phenomenon. It aims at looking for patterns or ideas that can be tested and developed into further research.

Descriptive research: This is a quantitative type of research that provides more information about a topic as much as possible. It helps to increase the knowledge about it by describing a phenomenon and its characteristics. This research collects data that can be used to answer a wide range of ‘What, When and How’ questions rather than the ‘Why’ pertaining to a particular group.

Explanatory: This is the type of research that attempt to connect ideas for proper understanding of the topic. Explanatory research explores why things occur with limited information. It explores questions without coming up with a definite conclusion. It is a form of quantitative research that helps in data collection in testing a hypothesis. It is also very useful in predicting the future based on the observations made.

Correlation: A correlational research investigates relationships between variables without the researcher controlling any of them. A correlation reflects the strength and direction of the relationship between two or more variables. The direction of a correlation can be positive or negative. (Pritha, 2022).

A positive correlation happens when both variables change in the same direction. Example is as the temperature increases, the volume of the gas increases. A negative correlation is when the variables change in opposite directions. Example: As the volume of a gas increases the pressure decreases.

When there is no relationship between the variables, it is a zero correlation.

Correlational research can also be used to predict the events from current data and knowledge.

3**. Operational definition in research**: is a definition of a concept in terms of specific, empirical measures. This is the statement of procedures the researcher is going to use to measure a specific variable. It should be clear, concise, and have detailed definition of a measure. It also establishes a consistent procedure for other researchers to replicate.

Scientists must precisely define the methods by which they perform experiments in research projects, they specify the operation or procedure that the researcher follows to obtain the measurement.(Ben Marcus Gillespie & John Richard Giardino, 2018)

In developing operational definitions, the following steps are used

1. Identify the independent and dependent variables
2. States clearly the nature of relationship existing between the variables
3. States the direction of the relationship
4. Implies the predicted relationship is testable empirically.

**4. Research Design**

A research design is a structural framework of various research methods as well as techniques that are utilized by the researcher.

Research design decides what data is required in research, what methods to use in collecting the data and how to analyse the data to be able to answer the research question. It is a compilation of information or data explored by setting a hypothesis and coming up with some findings in an organized way.

The essential elements of research design are as follows:

1. The method applied for analysing data
2. Type of research methodology
3. Probable objections for research

Research design can be categorized into two different perspectives: Quantitative research and Qualitative research.

Quantitative: (Team leverage Edu, 2021)

**5.** **Sampling and Data collection:**

Sampling is a method that allows researcher to select the group that they will collect data from. It is very important in research. To collect data, you need to determine the sample size and sample frequency.

Years ago, I was investigating the pH of rainwater, I had to do my sampling by collecting rainwater from different locations in the country. I collected about 50 samples at different points from different states of the country. This is to make my sampling effective and valid. Sampling helps to create a representative sample (smaller) that can represent the whole populace.

Sampling can be:

* Random
* Systematic
* Convenience
* Cluster
* Stratified.

A good sample should adequately reflect the population from which it is drawn. It should be valid with accuracy and precisions. It should be goal oriented. It should be proportional and large enough to represent the population under investigation. A good sample should be large enough to provide stability and reliability in statistical measurements. It should also be economical.

Data Collection is the process of gathering and measuring information on the variables of interest to answer research questions test hypothesis and evaluate outcomes. Data collection is the most important aspect of research work as it enables the researcher to take informed decisions based on the data. It is very demanding and needs thorough planning, patience and strategies to complete the task.

To collect data successfully, the starting point are as follows:

1. Data required for the research
2. Selection of sample from a certain population
3. Instrument needed for data collection.

Data can be collected from two sources. Primary and secondary sources. Primary data are also known as raw data, this is the data collected from the original source in a controlled or uncontrolled environment.

Controlled environmental data include experimental research when certain variables are controlled, while in an uncontrolled environment, data can be collected through survey, questionnaire, or observations.

Secondary data are data collected from secondary sources such as journals, books, magazines, websites and so on.

Methods of collecting data depends on the research design. Common methods include questionnaires survey, interview, and observations.

Questionnaires are very useful for both quantitative and qualitative research. It is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from the respondents.

Data can be quantitative or qualitative. Quantitative type of data is numerical and can be computed mathematically. Qualitative data however are not numerical, they are rather descriptive or nominal in nature.

Quantitative data uses different scale of measurement which can be classified as Nominal, Ordinal, Interval and Ratio scales.

Nominal Scale categorises items into different groups such as male and female, different shoe sizes etc. Ordinal scale provides more information than the nominal scale, it provides ranking of the data such as shoe sizes being ranked from small to big. Interval scale goes further to provide the units of measurement at equal intervals.

Questionnaires use different measuring scales to obtain information from respondents. For biodata, it uses the nominal scale while the ordinal scale is used to gather the preferences of the respondents. To obtain information relating to attitude, the rating scale is preferred.

**6. Theoretical Perspective**

Theoretical Perspective is a set of assumptions about reality that inform the questions we ask and the answers we arrive at as a result. It is a structural framework for interpreting observed data in research. Theories are explanations that have been tested and evaluated over time.

There are three main theoretical perspectives

* Functionalist Perspective
* Conflict Perspective
* Interactionist Perspective

Functionalist perspective is a relationship between the parts of the society. It looks at how aspects of society are functional or adaptive. From this perspective, the society is seen as a system of interrelated parts.

The parts of society while performing different functions work together to maintain the stability of the whole social system. Examples of this can be illustrated with biological systems where an organism consists of different unique parts that function together to support and maintain the whole system. In a family system also, everyone has a role and focus on their parts. Functionalists such as Emile Durkheim believe that society is held together by a social consensus or cohesion.

Robert Merton an American Functionalist Sociologist in 1910 divides the human functions into two types:

* **Manifest functions** which are intentional and obvious.
* **Latent functions** which are not easily apparent or obvious, they are unrecognized.

**7. Qualitative Research:** Qualitative research is the type of research that studies people and groups in their natural settings. it focusses on the descriptive form of data rather than numerical. Qualitative research relies on data obtained from interviews, questionnaires, and observations. Data collected are usually not numerical. This kind of research method is useful when researching people, in sociology, political science, anthropology, psychology, folklore etc.

Qualitative research follows the ‘what and Why’ of research because it is exploratory and can be used to generate hypothesis.

Qualitative research methods help to reveal the behaviour and perception of a target audience. The following methods are often used in qualitative research.

* One-on-one interview: this type of interview is in-depth and very common. It focusses one respondent at a time in a conversation. This method could be face to face or on phone has an advantage of collecting precise and meaningful data from the respondent.
* Focus group: The respondents here could be between 6-10. It aims at finding answers to ‘What’ ‘Why’ and ‘How’. This uses online survey rather than personal conversation. This is very useful for market research on new products and testing new concepts. (Adi, 2020)
* Ethnographic research: studies people in their naturally occurring environment.
* Record keeping this uses already existing data such as journals, books etc.
* Case study method
* Observations: Qualitative observations uses the 5 sensory organs and their functioning to observe characteristics.

Researchers use Qualitative research methods when

* Developing a new product or generating a new idea.
* Studying product brand to strengthening marketing strategy.
* Understanding purchase behaviour
* Studying reactions of audience to marketing campaigns. (Adi, 2020).
1. **Qualitative Data Analysis**: This is the process of gathering, structuring, and interpreting qualitative data to understand what it represents. Since qualitative data is not structured and non- numerical, the data are usually in form of text, such as open-ended responses to survey questions or user interview transcripts, audio and video recordings, photos, chat messages.

Analysis of qualitative data is a bit challenging compared to quantitative data that is numerical. There are no tools readily available for analysis except to use manual means, however a new development of an automated software is underway which has been found to be cheaper and faster.

Steps to Qualitative data analysis:

* Gathering and collecting qualitative data
* Organizing and connecting with the data
* Coding the qualitative data
* Analysing the data for insights
* Reporting on the insights derived from the analysis. (Dye, 2021)

There are variety of analysis techniques available, choice is usually determined by the specific research objectives and the kind of data gathered.

The common methods are as follows

* Content analysis: identifies the patterns that emerge from text by grouping content into words, concepts, and themes.
* Narrative analysis: useful for getting customers’ perspective on a specific issue.

Discourse Analysis: This helps in getting a thorough understanding of the political, cultural, and power dynamic that exist in specific situations.

* Thematic analysis: it helps to deduce the meaning behind the words used by people. It reveals deep insights into data and can be quantified. (Dye, 2021)
1. **The variables – Independent and Dependent**

Research variables of a scientific process are factors that can be manipulated and measured. Research variables for most of the research methods are Independent and dependent Variables.

The independent variable is the one that can be changed or manipulated by the researcher while Dependent variables is the one that is measured. The independent variable cannot be more than one or two tested in research while there can be several dependent variables. Example: testing the effect of salt on the boiling point of water. The independent variable will be adding different amount of salt while the temperature at which the water boils is measured as the dependent variable.

 A control variable is added to ensure not more than one variable is manipulated at the same time. Controlled variables are used to reduce the possibility of any other factor influencing changes in the dependent variable. In our example, the control variable will be to use same amount of water or could be maintaining the same starting temperature.

Another experiment is to test the light intensity on the rate of photosynthesis. The distance of bulb to the elodea plant in water can be manipulated as the independent variable, while the number of oxygen bubbles produced can be counted as the Dependent variable.

Independent variables determine the value of the Dependent variables. Independent variables take the form of experiment stimulus, it has two attributes which is either present or absent. They are the experiment controller while Dependent variables have attributes which are direct, or indirect. They are difficult to manipulate, so are experiment measure.

The relationship between the independent and dependent variable is the basis of most statistical tests, which establishes correlation thus allowing the researcher to accept or reject hypothesis and draw conclusions.

1. **Test Validity and Reliability:**

Validity is the extent to which the results measure what they are supposed to measure, while Reliability is the extent to which the results can be reproduced when research is repeated under the same conditions. Both concepts are important tools in evaluating the quality of a research.

Reliability test is performed by checking the consistency of results across time, across different observers, and across parts of the test itself while Validity is by checking how well the results correspond to established theories and other measures of the same concept. Reliability measures consistency while Validity is about accuracy of the measure.

A reliable result may not be valid, but a valid result is reliable. For instance, a faulty equipment can continue to give a reproducible result however, the result may not accurate and hence not valid.

‘A group of participants take a test designed to measure working memory. The results are reliable, but participants’ scores correlate strongly with their level of reading comprehension. This indicates that the method might have low validity: the test may be measuring participants’ reading comprehension instead of their working memory.’ (Middleton, 2019)

Types of reliability test include:

* Test-retest: This measures the consistency of a test over time.
* Interrater: When a result is consistent with different observers.
* Internal consistency: This measures consistency with different part of a test.

Types of Validity test includes:

* Concurrent Validity: this is a type of construct validity test that compares the current test with an already valid test.
* Content Validity: This is when a test can represent all the content of a particular construct.
* Predictive Validity: test used to predict other areas of performance.

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