Page 1 of 27 Pages in this Full pdf

MZO-009: Research Methodology
Guess Paper-1

Q1. What are the types of laws, activity and cardinal stages in Ranganathan's Spiral of Scientific Method?

Ans. According to Ranganathan, "Scientific Method makes intellection pursue any discipline perpetually round and round a never-ending succession of cycles". Figure 1.5 represents the endless Spiral of Scientific Method, propounded by Ranganathan. To show each sequential step and their movement, the spiral is divided into four quadrants by two lines perpendicular to each other, intersecting at the centre. This also results in four cardinal points.

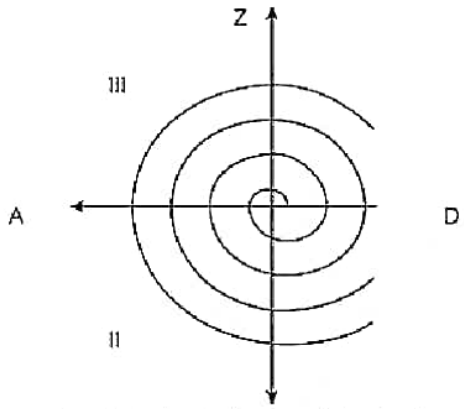

Fig.: Spiral of Scientific Method

Types of Laws, Activity and Cardinal Stages: The Spiral of Scientific Method comprises various types of laws, stages and intellectual activities as given below:

A) Types of Laws:
i) Fundamental laws
ii) Deduced laws
iii) Nadir facts
iv) Empirical laws

B) Types of Activities
i) Senses, experimentation, observation, concretisation and particularization
ii) Intellect, induction, abstraction and generalization
iii) Generalization, abstraction, sublimation and intuition
iv) Particularization, concretization, deduction and intellect

C) Cardinal Stages in the Cycle
i) Nadir
ii) Ascendent
iii) Zenith
iv) Descendent

The spiral moves forward in clockwise direction.
Lowest end of the vertical line is called nadir – literally means the lowest point.
Upper end of the vertical line is called Zenith – the highest point.
Left end of the horizontal line is called Ascendency, i.e., going upwards.
Right end of the horizontal line is called descendent, i.e., going downwards.
The four sections thus formed by the interesting lines are called quadrants. First quadrant is on lower-left side (i.e., South-West). Moving clockwise this way, the fourth quadrant is on the lower-right (i.e., South-East).
Spiral and its Quadrants and their descriptions
Quadrant I is between nadir and ascendent. Quadrant II is between ascendent and zenith. Quadrant III is between zenith and descendent. Quadrant IV is between descendent and nadir.

Page 2 of 27 Pages in this Full pdf

Quadrant 1 corresponds to the stage in the development of a subject in the universe of subjects, conforming to scientific method, in which:

1) Primary senses are used, either in their native state or with the aid of instruments of various intensity of powerfulness;

2) Observations are made of knowees, either with or without experimental inference and conditioning; and

3) Facts are found.

Quadrant 2 corresponds to the stage in which:

1) Intellect is used either by itself or aided by machinery constructed to speed up the work of the intellect and to provide relief to it in some measure;

2) Reasoning is made with the aid of inductive logic, including normal equations and statistical and other calculations to boil down the numerous facts, accumulated at the nadir to a small number of inducted or empirical laws; and inducted or empirical laws are formulated.

Quadrant 3 corresponds to the stage in which:

1) Intuition of some intensity is used, not mediated by the primary senses or the intellect;

2) The inducted or empirical laws stand, boiled down to a very small number of fundamental laws;

3) Progression towards ultimate generalization;

4) Progression towards ultimate abstractness; and

5) Seizing of fundamental laws and their recording.

Quadrant 4 with the use of intellect to the formulation and recording of deducted laws involves:

1) Use of intellect by itself or aided by machinery;

2) Reasoning with the aid of deductive logic including mathematical and other classes;

3) Progression towards particularization;

4) Progression towards concreteness;

5) Derivation of deducted laws and their recording;

6) Deducted laws must include one and all of the inducted empirical laws; and

7) The number of deducted laws exceeds that of the empirical laws if fundamental laws have been seized with intuition of adequate intensity.

Thus, we find the process of observation corresponds to quadrants 1 and 2, the process of formation hypothesis to quadrant 2 and testing of hypothesis to quadrant 4 in the cycle.

Two events occur upon re-entering the spiral:

1) Observations and experiments are made to verify the validity of new deduced laws;

2) Further continuous observation and experiment lead to the accumulation of new empirical facts. So long as the deduced laws are verified empirically to be true and the new empirical facts are found to be in conformity with the implication of the fundamental laws, there is no further movement in the spiral. As and when new empirical facts appear to contradict the new fundamental laws, scientific method is applied and new cycle get into full swing and carries the Spiral of Scientific Method further. The cycle is liable to be repeated without end. This method is easily applied to natural sciences because:

a) Observations can be impersonal;

b) Experiments can be made without hindrance; and

c) There has been continuous sharpening of mathematical calculation necessary to make induction and deduction.

Working of the Spiral

At the nadir lies is the problem to be solved. In this first quadrant (called empirical phase), data is collected empirically and the problem may be refined further. Data may be qualitative or quantitative. In the second quadrant (called hypothesis phase), the data is collected, tabulated, classified and analyzed. It is known as data processing. From the analysed data, cause-effect inferences are drawn or state-of-the-art, i.e., ground situation is assessed. The hypothesis is drawn by using inductive logic and intuition. In the third quadrant (called deductive phase), laws are deduced with the help of deductive logic. The fourth quadrant is also known as the verification phase. Here the laws formulated in the third quadrant are tested and verified; and further some higher generalization may be drawn. Statistical techniques may be used for verification and to support or disprove the hypothesis (Table 1.1).

Page 3 of 27 Pages in this Full pdf

Table 1.1: Ranganathan's Spiral (Source: Sharma, 1990)

Quadrant	Span/Situation	Phase of Research	Method/Tool
I	N –A South-West	Empirical	Experience and observation/ literature survey
II	A-Z North-West	Hypothesizing	Intitution and Imagination
III	Z-D North-East	Deductive	Intellection/ Logic/ Statistics
IV	D-N South-East	Verification	Applications/ Math ematics

The spiral is not anyhow 'to do it' method, but highly generalized and provides overview of the research process as observed from a distance. This mostly pertains to research in a major discipline rather than to any individual research problem. In actual practice, there cannot be clear dividing lines, as the researcher has to run to and fro many times during the lengthy process. Scientific method is objective-transparent, replicable to solve problems by discovering new information than any specific area of application. Any knowledge discovered by this procedure is scientific.

Social research has been defined by Pauline V. Young in her book Scientific Social Surveys and Research as a "Scientific understanding which by means of logical and systematised techniques, aims to:

1) discover new facts or verify and test old facts;

2) analyze their sequences, interrelationships and causal explanations which were derived within an approximate frame of references;

3) develop new scientific tools, concepts and theories which would facilitate a reliable and valid study of human behaviour. The primary goal of a researcher is to explore and gain an understanding of human behaviour vis-a-vis social life, and thereby gain a greater control over them. In other words, social research is a systematic method of exploring, analyzing and conceptualising social life in order to "extend, correct or verify knowledge, aid in the construction of a theory or in the practice of an art." Social research seeks to find explanations to unexplained social phenomena, to clarify the doubtful and correct the misconceived facts about social life. Social research also aims at discovering laws of human behaviour, but they are more tentative than scientific laws on account of their dependence on uncontrollable behavioural data.

The spiral of scientific method is thus open-ended in nature, and has unlimited scope for hospitality of various rounds in any field of activity.

Q2. What are the criteria for selecting a research topic?

Ans. One of the most difficult phases in research, particularly for students who wish to take up research for higher degrees, is the selection of research topic. The choice and selection of a research topic is crucial because the topic should lend itself for investigative studies and promise some useful and tangible results. According to Busha and Harter, researchers "have a responsibility to search for real solutions to both practical and theoretical problems. Productive research is the product of test of propositions or searches for answers to exploratory questions; however, these activities cannot be accomplished unless a need for specific information has been recognized and pertinent phenomena have been pinpointed that can be observed, interpreted and evaluated. Thus, the selection of a topic for a disciplined inquiry is a key element of the research process". It is, therefore important to discuss here a few useful criteria or a set of guidelines for the selection of a topic for research. A few sources that might help identifying a field and a topic are discussed below.

A fast developing field like computer software development wherein many applications are constantly in demand may pose problems, needing solutions. Similarly, biotechnology and genetic engineering are the fields where

Page 4 of 27 Pages in this Full pdf

students are likely to face challenging problems for research investigations of applied nature. Senior professionals with a great deal of experience and expertise may help students by suggesting areas of research and selecting topics for research. They can also guide students at every stage of the research process. Academic and professional institutions and cognate bodies, as well as funding agencies may have lists of topics for study and investigation in library and information fields.

Research projects of industries or governments wherein information is a component for study and research may engage research professionals to investigate their problems for solutions. Lists of topics of these bodies, for investigations and research, may also be useful for getting an idea of research areas to research students in any relevant area.

Apart from the selection of topics for research, a researcher must have certain quality and competence to take up research studies. In-depth knowledge of the subject with a research bent of mind, combined with practical experience in the field are essential requirements for research. Hard work, devotion, dedication, etc. are additional inputs that could enhance the capacity to think, collect information and data systematically and record them accurately for easy retrieval when needed.

Q3. Give a broad overview of the concepts of attributes in research.

Ans. Reliability is used to characterize stable, consistent and dependable research methods, instruments, data or results. Validity is the essential characteristic of the entities, procedure or devices to measure several dimensions. Objectivity and subjectivity are characteristics that affect the research results in the sense that any personal bias (that is subjective) may vitiate research results. Intuition is an important element in research. A person who is involved in a research project is likely to be constantly thinking about the research process and its progress. An idea may suddenly flash in the mind of a researcher that could sort out a ticklish problem where the progress of work had got struck up. Four essential design attributes, viz., construct validity, external validity, internal validity and statistical conclusion validity, can be used to assess the quality of research designs.

i) Internal validity is also referred to as causality. This attribute examines whether the observed change in a dependent variable is caused by a corresponding change in hypothesized independent variable, and not by variables extraneous to the research context. Internal validity is strong for laboratory experiments, where the independent variable (cause) can be manipulated through any treatment and the effect (dependent variable) can be observed after some point of time. Field surveys are poor in internal validity because of their inability to manipulate the independent variable (cause), and because cause and effect are measured at the same point in time.

ii) External validity is also referred to as generalizability. It refers to the extent to which the observed associations can be generalized from the sample to the population (population validity) or to other individuals, groups, organizations or periods of time (ecological validity). Comparing survey research to laboratory experiments, the former typically has broader generalizability. Higher degrees of internal and external validity are seen in research designs such as multiple case studies, field experiments and longitudinal field surveys.

iii) How accurately a particular scale measures the theoretical construct that it is intended to measure is determined by its construct validity.

iv) The validity of conclusions drawn from statistical procedures is assessed through the process of statistical conclusion validity. It assists us in determining whether the appropriate statistical technique was employed to test the hypothesis or whether the variables utilized adhered to meet the assumptions of that statistical test.

Q4. Distinguish between primary and secondary data sources.

Ans. Primary Sources: A primary source is a document that contains the original statement on the topic being investigated by the researcher. These contain evidence that is closest to the event under investigation as recounted by observers and participants. Primary sources represent "the data which lie closest to the historical event. They are considered to include the testimony of eyewitnesses or observations made with one or the other senses or by some mechanical device. In most cases, primary sources are the written record of what the researcher actually observed or the first-hand expression of his or her thoughts". Thus, it is the direct outcome of the event or the record of eyewitnesses. It bears direct involvement with the event being studied, such as diaries, letters, speeches and

Page 5 of 27 Pages in this Full pdf

interview with the person who personally experienced the event, original map, etc. It is not a copy, a repackage or summary of the original.

These include the following:

- Documents generated by the events themselves such as archival records (governmental, institutional, commercial, ecclesiastical, etc), internal letters and memoranda (memos), speeches, summaries or minutes of conferences and meetings, photographs of people, buildings and equipment, statistical information (such as tally sheets and surveys), lists of holdings (goods, equipments, etc), and reports and statements (mission statements, employee guidelines, rules and regulations, etc);
- Documents produced to record events immediately such as chronicles, diaries or reports produced by journalists and interviews conducted by them, drawings and photographs, motion picture films and video recordings;
- Documents in supplementary forms produced much later in the form of oral sources, oral traditions and folklores, languages themselves, say fables, folktales, folklore etc are a good source; and
- Artifacts or realia such as inscriptions, seals, coins, medals, drawings, pictures, ruins of monuments, etc.

Secondary Sources: A secondary source is the one derived or created from a primary source (that first reported the event being studied). It reports events based on the use of primary and other secondary sources as bases of data collection. It contains information reported by a person who did not directly observe the event, object or condition. Thus, these sources report events by a person other than a direct observer or a participant in the events. These are considered less useful than primary sources.

A secondary source may be one or more steps removed from the primary source in terms of time, place or authorship. A source becomes primary or secondary, depending upon its proximity to the actual event under investigation. A secondary source (a copy produced from an original document) may not be an authentic one. In copying from the original documents, certain errors can creep in through omission or commission. The original may have been modified, through editing or interpretation.

Q5. What are the various problems faced in a research work?

Ans. a) Data

Amount of Data: Often, it is difficult to decide as to how much data is sufficient to reach meaningful conclusions.

Selection of Data: A researcher must avoid improper or faulty selection of data. This may occur due to relying too heavily on some data, ignoring some data, etc. This can result in a bias in the study.

Evaluation of Historical Data and their Sources: Inadequate evaluation of data and their sources, can lead to misleading results.

Synthesis of Data into a Narrative Account: Due to the very nature of historical research, it becomes most fruitful, if a researcher is able to successfully synthesize or integrate the facts into meaningful generalizations. Thus, a failure on the part of a researcher to interpret data adequately is considered a serious setback.

There are four problems at the stage of synthesis and in report preparation as given below:

1) Trying to infer causation from correlated events is the first problem. Just because two events occurred together does not necessarily mean that one event was the cause of the other.

2) A second problem is defining and interpreting key words so as to avoid ambiguity and to ensure that they have the correct connotation.

3) A third problem is differentiating between evidence, indicating how people should behave and how they in fact did behave.

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b) Sources

Heavy use of secondary sources of information: In case of research into events that occurred in a period earlier than the recent ones, a researcher often has to depend heavily on secondary sources due to lack of primary sources.

c) Broad Area or Problem

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