

1 Scientific Research: Characteristics, Types and Methods

SCIENCE AND COMMON SENSE

Many a time we make certain statements which we have not to prove that they are true. They are based either on common sense or on practical observations and experiences on social life, though sometimes they may be based on wisdom too. However, often they are based on ignorance, prejudices and mistaken interpretation. Common sense knowledge, based on the accumulated experiences, prejudices and beliefs of the people, is often contradictory and inconsistent. On the other hand, scientific observations are based on verifiable evidence or systematic body of proof that can be cited. For example, some common sense statements may be quoted here: man is more intelligent than woman; married people remain more happy than single people; high-caste people are more talented than low-caste people; the rural people are more hardworking than the urban people; urban people are more Congress-oriented than BJP-oriented; and the like. Contrary to this, the scientific research or scientific inquiry finds that woman is as intelligent as man; there is no association between happiness and remaining married or unmarried by a person; caste does not determine individual's efficiency; hard work is not related to environment alone; and urban people are not necessarily Congress-oriented. Thus, a statement made on common sense basis may be just a guess, a hunch, or a haphazard way of saying something, generally based on ignorance, bias, prejudice or mistaken interpretation, though occasionally it may be wise, true, and a useful bit of knowledge. At one time, common sense statements might have preserved folk wisdom but today, scientific method has become a common way of seeking truths about our social world.

Conant ("Science and Common Sense", 1951, quoted by Fred. N. Kerlinger in *Foundations of Behavioural Research*, 1964:4) has differentiated science and common sense in the following five ways:

(i) Use of conceptual schemes

Though conceptual schemes are used in both science and common sense but in common sense, the man in the street uses them in a loose fashion while the scientist systematically builds his conceptual and theoretical structures and tests them for consistency. For example, on a common sense basis, a person's birth in a Dalit caste is described as a result of his past *karmas*, the death of a corrupt person's son is thought to be a punishment for his sinfulness, lack of rains is due to displeasing Indra—the rain-god—and so forth. The scientist describes such conceptual ideas and feelings as having no relation to reality.

(ii) Empirical tests

The scientist tests his hypotheses and theories through a systematic empirical testing but the man in the street tests his so-called hypotheses and theories in a selective way. He often 'selects' evidence simply because it suits his hypotheses. For example, in the past, a common man's belief in India was that all untouchables are dirty, lethargic and superstitious. He 'verified' his belief by noting that all untouchables are so and described those who were not so as 'exceptions'. The sophisticated social scientist rejects such 'selective tendency'. Instead of giving an armchair explanation of a relationship, he believes in 'testing' the relationship in the field/laboratory.

(iii) Notion of control

In scientific research, 'control' means focusing on those variables that are hypothesised to be the 'causes' and ruling out those that are 'possible causes' of the effects on the phenomenon under study. The layman seldom bothers to control any variables or extraneous sources of influence. He accepts all those factors which are in accord with his preconceptions. For example, if a layman assumes that inter-community riots are initiated by anti-social elements, he will talk only of this factor and never bother of other factors like the role of religious fanatics, politicians with vested interests, support of 'foreign' elements through cash and weapons, role of 'interested' businessmen, and the like. The scientist, on the other hand, will not discard the role of all these factors but would rather 'control' the study of communal riots in terms of different variables.

(iv) Relations among phenomena

The difference between science and common sense in terms of relations among phenomena is perhaps not so sharp because both talk of relations. However, while the scientist consciously and systematically pursues relations, the layman does not do this. His concern with relations is loose, unsystematic and uncontrolled. He often seizes on the fortuitous occurrence of two phenomena and immediately links them as cause and effect. Take, for example, the relation between crime and punishment. A layman says that punishment controls crime while a scientist says that punishment can make a criminal a more confirmed enemy of society and that rewards also can control crime. Thus, while a scientist would 'test' both relations, a layman would ignore 'reward' factor.

(v) Explanation of observed phenomena

One main difference between common sense and scientific explanation of observed phenomena is that the scientist carefully rules out philosophical and metaphysical explanations in explaining relations among the observed phenomena because these cannot be tested. For example, saying that the poverty of a person is because God wishes it so is talking metaphysically, since this proposition cannot be tested.

All these differences between science and common sense indicate that a scientist gives statements and propositions which can be empirically verified but a layman does not believe in testing and validity. In short, the method of science is different from the methods of *intuition* (accepted by the *a priorist* because it is agreeable to reason if not with experience) or *tenacity* (fact is true because it is known to be true and the repetition enhances its validity).

EMPIRICISM (POSITIVISM) v/s PHILOSOPHICAL APPROACH

The study of society and social phenomena till the middle of the nineteenth century was made mostly on the basis of speculation, logic, theological thinking and rational analysis. August Comte, a French philosopher, described these methods inadequate and insufficient in the study of social life. In 1848, he proposed *positive method* in the field of social research. He maintained that social phenomena should be studied not through logics or theological principles or metaphysical

theories but rather in society itself and in the structure of social relations. For example, he explained poverty in terms of the social forces that dominate society. He described this method of study as *scientific*. Comte considered scientific method, called *positivism*, as the most appropriate tool of social research. This new methodology rejected speculation and philosophical approach and focused on gathering of empirical data and became *positivistic methodology*, using similar methods as employed by natural sciences. By the 1930s, positivism came to flourish in the USA and gradually other countries also followed the trend.

Comte's positivism (that knowledge can be derived only from sensory experience) was criticised both from within and outside the positivist domain. Within positivism, a branch called *logical positivism* was developed in early twentieth century which claimed that science is both *logical* and also based on observable facts and that the truth of any statement lies in its verification through sensory experience. Outside positivism developed schools of thought like symbolic interactionism, phenomenology and ethnomethodology, etc. These schools questioned the positivist methodology and its perception of social reality.

Frankfurt and Marxist schools also sharply criticised positivism. But *empiricism* came to be accepted more in the 1950s and 1960s onwards by the academics. Today some writers refer to the emergence of a new stage of research, the *post-empiricist* research marked by the notion that the scientific method is not the only source of knowledge, truth and validity (Sarantakos, *Social Research*, 1998:5). Thus, today, sociological methodology is no longer based on *positivist* methodology as in the past but it has become a body of diverse methods and techniques, all of which are perceived as valid and legitimate in social research.

We have thus today two approaches to social science research: the scientific empirical method and the naturalistic phenomenological method (Robert B. Burns, *Introduction to Research*, 4th ed., 2000:3). In the former, quantitative research methods are employed in an attempt to establish general laws or principles. This approach, also termed as *nomothetic*, assumes that social reality is objective and external to the individual. The latter approach to research emphasises the importance of the subjective experience of individuals, with a focus on qualitative analysis. It regards social reality as a creation of individual conscious-

ness, with evaluation of events seen as a personal and subjective construction. This approach (with focus on individual case rather than general law-making) is termed as *ideographic* approach.

SCIENTIFIC RESEARCH OR SCIENTIFIC METHOD IN CONDUCTING RESEARCH

The first question is: what is research? Research is a careful and exhaustive investigation of a phenomenon with an objective of advancing knowledge. According to Theodorson and Theodorson (1969:347), "it is a systematic and objective attempt to study a problem for the purpose of deriving general principles". Robert Burns (2000:3) describes it as a systematic investigation to find solutions to a problem. The investigation is guided by previously collected information. Man's knowledge grows by studying what is already known and revising past knowledge in the light of new findings. Activity undertaken for the purpose of personal learning or enlightenment or any causal investigation is not research.

While talking of research, sometimes we talk of empirical (scientific) research and sometimes of library research, historical research, social research, and so on. *Empirical research* involves observation of facts or interaction with people. *Library research* is done in library situation. *Historical research* is the study of history (e.g., functioning of caste system in different periods of history) or biographical research (e.g., research into the life and times of Mahatma Gandhi). *Social research* is a research that focuses on the study of human groups or the processes of social interaction. *Scientific research* is building of knowledge through collection of empirically verifiable facts. The term 'verifiable' here means "which can be checked by others for accuracy". Kerlinger (op.cit., 1964:13) has defined scientific research as "a systematic, controlled, empirical and critical investigation of hypothetical propositions about the presumed relations among phenomena". Three points that have been emphasised here are: (i) it is *systematic* and *controlled*, i.e., the investigation is so ordered that investigators can have confidence in research outcomes. In other words, the research situation is tightly disciplined; (ii) investigation is *empirical*, i.e., subjective belief is checked against objective reality; and (iii) it is *critical*, i.e., the researcher is critical not only of the results of his own inquiry but of the research results of others too. Though it is easy to err, to exaggerate, to over-generalise when writing up one's own

work, it is not easy to escape the feeling of scientific eyes of others.

Royce A. Singleton and Bruce C. Straits (*Approaches to Social Research*, 1999:1) have said that "scientific social research consists of the process of formulating and seeking answers to questions about the social world". For example, why do husbands batter their wives? Why do people take drugs? What are the consequences of population explosion? and so on. Similarly, the issues of inquiry may be of rural poverty, urban slums, youth crime, political corruption, exploitation of the weak, environmental pollution, and the like. To answer these questions, social scientists have devised basic guidelines, principles and techniques. Scientific social research thus investigates any curiosity about *social* phenomena, utilising scientific method. Scientific sociological research, broadly speaking, is concerned with discovering, organising and developing systematic reliable knowledge about society or social life, social action, social behaviour, social relations, social groups (like families, castes, tribes, communities, etc.), social organisations (like social, religious, political, business, etc.), and social systems and social structures.

Theodorson and Theodorson (1969:370) have maintained that scientific method is "building of a body of scientific knowledge through observation, experimentation, generalisation and verification". Their contention is that scientific inquiry develops knowledge experienced through the senses, i.e., which is based on empirical evidence. According to Manheim (1994:77), scientific research involves a method characterised by objectivity, accuracy and systematisation. Objectivity eliminates biases in fact-collection and interpretation: Accuracy makes sure that things are exactly as described. Systematisation aims at consistency and comprehension.

The assumption is that any statement pertaining to any social phenomenon made on the basis of scientific inquiry can be accepted as true and meaningful, if it is empirically verifiable. Thus, individual's idiosyncratic observations not shared by all scientists are not regarded as 'scientific facts'. For example, a statement that "skilled workers are more indisciplined than non-skilled workers" lacks empirical validity; hence no one will accept it as a 'scientific fact'. But, if a statement is given that "the important cause of child's delinquent behaviour is a disorganised family", it will be taken as scientific, considering it a proposition which has been found valid in a number of studies. "About whom" the facts will be collected in a scientific inquiry will

depend upon the 'focus of the discipline' to which the researcher belongs. If the researcher is a sociologist, he will collect facts about social phenomena or social world. But if he is a student of business administration (MBA), he will collect facts pertaining to "different aspects of business like finance, marketing, personnel, and the process that facilitates the managerial decision-making and problem-solving". In sociology, social inquiry will help the researcher and the people to understand the social phenomenon (say, a social problem like exploitation of the weak, poverty, political corruption, etc., or the structure of political parties, or the functioning of political elite, or social institutions in a village community, and so on), or to understand why the behaviour of an individual in a group (crowd) is different from the one when he is in isolation (crowd behaviour) or how the behaviour patterns of a number of persons change when they respond to a common stimulus (collective behaviour), or why and how the patterns of interaction within a small group or of interrelationships of one group with other groups are effective in communication and decision processes (group dynamics).

In business administration, according to Zikmund (1984:56-57), the scientific inquiry will help managers to clarify their objectives and decisions. For example, a manager of an organisation wants to find out why has the morale of the subordinates declined? Is it because the overtime has been totally stopped or the employees for higher posts are directly recruited and the serving employees have no opportunities for seeking higher posts, or the employer has developed the tendency of appointing persons on contract basis, or the credit facility provided earlier by the organisation has been stopped, or the profits are not being shared by the employer with the employees, or the employer has refused to provide housing facilities even to senior employees, and so forth. Thus, while the major areas of inquiry/research for a sociologist would be individuals, groups, organisations, institutions, communities, systems, structures and societies, for social inquiry or research in business administration, the major areas would be accounting, personnel, sales and marketing (advertising, buyer's behaviour), responsibility (legal, constraints) and general business (i.e., location, trend, import and export, etc.).

Although scientific research method depends on the collection of empirical facts, yet facts alone do not constitute a science. For meaningful understanding facts must be ordered in some fashion, analysed,

generalised, and related to other facts. Thus, theory construction is a vital part of the scientific inquiry.

Since facts collected and findings evolved through the scientific method are interrelated with the previous findings of other scholars or earlier theories, scientific knowledge is a cumulative process.

The scientific method could either be an *inductive* method or the *deductive* method. Inductive method involves establishing generalisations, i.e., building generalisations inferred from specific facts, or drawing particular principles from general instances, while deductive method involves testing generalisations, i.e., it is the process of reasoning from general principles to particular instances.

Research and theory are not opposed to each other. Research leads to theory and theory to research. In fact, descriptive research leads to explanatory research which leads to theoretical research.

According to Singleton and Straits (op. cit.: 5-9), there are four research strategies for understanding the social world: (1) experiments (2) surveys, (3) field research, and (4) use of available data. *Experimental research* offers the best approach for investigating the causes of phenomena. In the experiment, the researcher systematically manipulates some feature of the environment and then observes whether a systematic change follows in the behaviour under study. *Survey research* involves the administration of questionnaires or interviewing relatively large groups of people. *Field research* is engaging oneself in naturally occurring set of events in order to gain firsthand knowledge of the situation. The *available data* are the data that have been generated for purposes other than those for which the researcher is using them, e.g., written records, newspapers, government documents, books, diaries, etc.

✓ CHARACTERISTICS OF SCIENTIFIC RESEARCH

Horton and Hunt have given following nine characteristics (1984:4-7) of scientific method:

- *Verifiable evidence*, i.e., factual observations which other observers can see and check.
- *Accuracy*, i.e., describing what really exists. It means truth or correctness of a statement or describing things exactly as they are and avoiding jumping to unwarranted conclusions either by exaggeration or fantasising.

- *Precision*, i.e., making it as exact as necessary, or giving exact number or measurement. Instead of saying, "I interviewed a large number of people", one says, "I interviewed 493 persons". Instead of saying, "most of the people were against family planning", one says, "seventy two per cent people were against family planning". Instead of saying, "every moment one is born; every moment dies a man", one says, "thirty persons are born in one minute in India". Thus, in scientific precision, one avoids colourful literature and vague meanings. How much precision is needed in social science will depend upon what the situation requires.
- *Systematisation*, i.e., attempting to find *all* the relevant data, or collecting data in a systematic and organised way so that the conclusions drawn are reliable. Data based on casual recollections are generally incomplete and give unreliable judgements and conclusions.
- *Objectivity*, i.e., being free from all biases and vested interests. It means, observation is unaffected by the observer's values, beliefs and preferences to the extent possible and he is able to see and accept facts as they are, not as he might wish them to be. The researcher remains detached from his emotions, prejudices and needs, and guards his biases. A *bias* is an unconscious tendency to see facts in a certain way because of one's wishes, interests and values. For example, the protest demonstration of students in a university may be perceived by some as a logical effort for the welfare of the students while others may see it as a misguided method of getting the grievances mitigated. The researcher who wants to see it objectively will present all facts and views of students, teachers, administrators, etc. He will neither attempt to overlook some facts deliberately nor emphasise some other facts, as he himself will not be emotionally involved in the situation. He will make conscious effort to be accurate in information he collects or what he hears and sees. As an objective researcher, he will have no vested interest in reporting and analysing facts. The researcher is also conscious of the fact that others with a different point of view can check and criticise his analysis. Being afraid of shoddy exposure of his research, he will not permit his biases to affect his results and conclusions.
- *Recording*, i.e., jotting down complete details as quickly as possible. Since human memory is fallible, all data collected are

recorded. Researcher will not depend on the recalled facts but will analyse the problem on the basis of the recorded data. Conclusions based on recalled unrecorded data are not trustworthy.

- *Controlling conditions*, i.e., controlling all variables except one and then attempting to examine what happens when that variable is varied. This is the basic technique in all scientific experimentation—allowing one variable to vary while holding all other variables constant. Unless all variables except one have been controlled, we cannot be sure which variable has produced the results. Though a physical scientist is able to control as many variables as he wishes in an experiment he conducts in the laboratory (say, heat, light, air pressure, time interval, etc.) but a social scientist cannot control all variables as he wishes. He functions under many constraints. For instance, a researcher wants to study the behaviour of students in a classroom. Now, students' behaviour in a classroom depends upon several factors, like efficiency of the teacher of communicating his views, subject which is being taught, availability of black-board, fan, etc., in the room, quietness in the verandah outside the classroom, and so forth. A researcher may be able to control some of these variables but not all. Varying conditions will be responsible for varying behaviour of the students. It is, however, possible for a researcher in social science to work with two or more variables at a time. It is called multivariate analysis. Since the social scientist is not always able to control all the variables he wants, his conclusions do not permit him to predict.
- *Training investigators*, i.e., imparting necessary knowledge to investigators to make them understand what to look for, how to interpret it and avoid inaccurate data collection. When some remarkable observations are reported, the scientist first tries to know what is the observer's level of education, training and sophistication? Does he really understand facts he reports? The scientists are always impressed by authenticated reports.

All above characteristics of scientific method point out that any generalisation based on this type of investigation is true. A systematically collected body of scientific evidence is rarely challenged. No wonder, Zikmund has also said that the data collected haphazardly can not be described as scientific inquiry.

Henry Johnson has stated following four characteristics of scientific research (see, Black and Champion, 1960: 5-6):

1. *It is empirical*, i.e., it is based on observation and reasoning and not on speculation.
2. *It is theoretical*, i.e., it summarises data precisely giving logical relationship between propositions which explain causal relationship.
3. *It is cumulative*, i.e., generalisations/theories are corrected, rejected and newly developed theories are built upon one another.
4. *It is non-ethical*, i.e., scientists do not say whether particular things /events/phenomena/institutions/systems/structures are good or bad. They only explain them.

Robert B. Burns (2000:5-7) has discussed four characteristics of scientific approach: control, operational definition, replication and hypothesis testing.

Control is necessary to eliminate the simultaneous influence of many variables to isolate the cause of an effect. Control provides unambiguous answers to why something happens, what causes some event or under what conditions an event does occur.

Operational definition means that the terms must be defined in terms of steps to measure them; e.g., economic class may be defined by family income, and social class by father's occupation or both parents' educational level.

Replication means that for repeated study, the data obtained must be reliable. If observations are not repeatable, our descriptions and explanations are unreliable and useless.

Hypothesis testing means that the researcher systematically creates a hypothesis and subjects it to empirical test.

AIMS OF SOCIAL RESEARCH

The aims of social research coincide with the type of research, i.e., whether it is exploratory research or explanatory research or descriptive research. In other words, it depends upon the general goals (understanding for its own sake), the academic goals, the theoretical goals and the pragmatic goals of research. Broadly speaking, the important aims of social research are:

- To understand the functioning of society.
- To study individual behaviour and social action.

- To evaluate social problems, their effects on society, and to find out possible solutions.
- To explore social reality and explain social life.
- To develop theories.

Becker (1989) and Sarantakos (1998:16) have referred to the following goals of social research:

- *General goals*: Understanding for its own sake.
- *Theoretical goals*: Verification, falsification, modification or discovery of a theory.
- *Pragmatic goals*: Solution of social problems.
- *Political goals*: Development of social policy, evaluation of programmes, planning of reconstruction, empowerment and liberation.

Sometimes the aims of social research coincide with the motives of social research but not always. The motives can be *intrinsic* (i.e., related to personal interests of the researcher) or *extrinsic* (i.e., related to the interests of those contracting the research). Mahr (1995:84) has outlined the following *motives* of social research:

- *Educational*: to educate and inform the public.
- *Personal*: to promote the academic status of the researcher.
- *Institutional*: to enhance the research quantum of the institutions for which the researcher works.
- *Political*: to provide support to political plans and programmes.
- *Tactical*: to delay decision or action for as long as the investigation is under way.

STEPS IN SCIENTIFIC RESEARCH

According to Theodorson and Theodorson (1969:370-371), scientific method involves the following steps: *First*, the problem is defined. *Second*, the problem is stated in terms of a particular theoretical framework and related to relevant findings of previous research. *Third*, a hypothesis (or hypotheses) relating to the problem is devised, utilising previously accepted theoretical principles. *Fourth*, the procedure to be used in gathering data to test the hypothesis is determined. *Fifth*, the data are gathered. *Sixth*, the data are analysed to determine if the hypothesis is verified or rejected. *Finally*, the conclusions of the study are related to the original body of theory, which is modified in accordance with the new findings.