UNIT 2 KNOWLEDGE GENERATION: HISTORICAL PERSPECTIVE-I

Structure

2.1 INTRODUCTION

In Unit I it has been clarified that research in social sciences in general and in education in particular, is a scientific process of generating knowledge. Man has been generating knowledge from the dawn of civilization on the basis of his life experiences, teachings from authority, influences from customs, traditions and socializing agents like educational institutions. Generating knowledge or discovering truth has also been largely possible by the use of deductive and inductive reasoning. Looking into the limitations of these two processes of reasoning, scholars integrated the most important aspects of deductive and inductive methods, shaping out scientific method or approach to knowledge generation. This has been the fundamental approach to research and hence to generation of knowledge.

In this unit, we shall look into the evolution of the knowledge generation process in a historical perspective from earliest times to modern days.

2.2 OBJECTIVES

After having studied this unit you will be able to :

- discuss that research generates knowledge;
- explain that different facets of the knowledge generation process have evolved through time;
- discuss various sources of knowledge.
- differentiate between knowledge generation through inductive and deductive modes of reasoning;

- explain the meaning of scientific method;
- justify the scientific method as a more scientific mode of knowledge generation than other modes;
- examine the process and limitations of Aristotellian deduction;
- examine the process and limitations of Baconian induction.

2.3 SOURCES OF KNOWLEDGE

Man needs knowledge and generates it for the purpose of his life activities. Without going into the theory of knowledge (epistemology), it may be considered that what we call 'Knowledge' is the product of knowing, perceiving, thinking, guessing, being mistaken, remembering, finding out, inferring, proving, reflecting, imagining and so on. Knowledge may be in the form of fact, belief or judgement. A fact is anything that exists or can be conceived of; what we claim to know is belief or judgement. Human knowledge takes the form of belief or judgement about a particular phenomenon. Some beliefs may be supported by evidence, may be based on our perceptions and experiences. The beliefs, which are supported by evidence are called justified beliefs. Only justified beliefs are knowledge. Knowledge includes what we know about matters of fact as well as the principles and processes of inference. It has three elements:

(i) there is a system of ideas;

(ii) the ideas correspond to things actually existing;

(iii) there is belief in such correspondence.

If we look at the historical perspective it will be evident that efforts of centuries were required by man to improve his capacity and readiness to obtain reliable knowledge. To gain some insight into the tortuous pathway he traversed, the following discussions briefly examine the various sources of knowledge he has drawn upon to solve problems. These are

(i) Life experiences,

(ii) Authority,

(iii) Customs and tradition,

(iv) Deductive reasoning,

(v) Inductive reasoning,

(vi) Scientific Method.

2.3.1 Life Experiences

In order to conduct his life activities satisfactorily and successfully man has to understand his environment and the nature of phenomena it presents to his senses, otherwise he can hardly hope to solve problems he faces constantly. One of the means by which man seeks the answers to his problems are his life experiences. Perhaps the most primitive, and yet the most fundamental source of the solution to a problem lies in personal experiences. Thus, confronted with a sudden flow of water down a ravine, prehistoric man could have solved his problem and saved his life if he had only remembered that water does not generally stay on hills. On an elementary level he had the knowledge of a basic scientific fact that water runs downhill. In ancient times, nomads and various tribes from their personal experience probably remembered that certain wild fruits always made them ill, that grains ripen at particular times of the year, and that sudden floods in the rivers during rainy season were due to the fact that water does not generally stay on hills. A young man can repair a puncture in a bicycle inner tube because he has done it several times previously. People may thus draw upon their own individually accumulated body of knowledge and skills derived from encounters and acquaintance

with facts and events in their environment. However, one has to keep in mind the limitations of personal experiences as a source of knowledge. Although experience is a familiar and well-used source of knowledge, it still may be inappropriate for new problems. Also, an uncritical use of personal experience may lead to erroneous conclusions. People may make errors when observing or reporting what they have seen or done. They may

- Omit evidence that does not agree with their opinion;
- Use measuring instruments that entail many subjective estimates;
- Establish a belief on insufficient evidence;
- Fail to observe significant factors relating to a specific situation; or
- Draw improper conclusions or inferences owing to personal prejudices.

In general, it may be observed how one is affected by an event depends upon who the one is. Two persons will have very different experiences in the same situations. For instance, two supervisors observing the same classroom at the same time could truthfully compile very different reports if one focused on and reported the things that went right and the other focused on and recounted the things that went wrong.

2.3.2 Authority

Seeking and accepting the explanation of authorities is a well-established method of getting knowledge and solving problems encountered in the environment. When one has not had personal experience with a phenomenon, the obvious recourse is to consult their parents, their teachers, or even their older siblings for answers to problems with which they are not familiar. Rather than attempting to determine truth independently, people often seek the advice of experts who, because of their intellect, training, experience, or aptitudes, are better informed than other people. Experts are necessary in a complicated culture such as ours where knowledge is expanding so rapidly that no one can be an expert at everything. And obviously certain individuals have such a wide experience and deep insight that their advice can be of immense benefit. But it should never be forgotten that as sources of knowledge, authorities have limitations. Authorities cannot be infallible. They may at times be in disagreement among themselves on issues. This shows that their authoritative statements are nothing but personal opinions, and not facts. We should, therefore, check their agreements and evidence upon which they base their claims to knowledge. Accepting experts' opinions unconditionally, thus, may lead us to untruth rather than knowledge.

2.3.3 Customs and Tradition

It goes without saying that customs and tradition serve as sources of knowledge for the members of a particular society and culture. They depend on custom and tradition for answers to many questions related to their professional and everyday problems. People usually and readily accept customary modes of dress, speech, food, worship and etiquette. In practical life this automatic acceptance of approved patterns of behaviour is often necessary, because one cannot question all things. In fact, custom and tradition have been especially useful influences in school setting, where educators often rely on past practices as a dependable guide. But the limitations of custom and tradition as sources of knowledge should not be lost sight of. One should not make the mistake of assuming that everything that has customarily been done is right or that an appeal to the accumulated knowledge and wisdom of ages will always lead to the truth. For instance, an examination of history of education reveals that many traditions that had prevailed for years were later found to be erroneous and had to be rejected.

2.3.4 Deductive Reasoning

Reasoning is inherently a thinking process. Man has recourse to reasoning in order to obtain reliable knowledge. He attempts to comprehend the world around him by applying

the faculty of reasoning. There are two types of reasoning: deductive and inductive. Deductive reasoning can be considered as a thinking process in which one proceeds from general to specific statements through logical arguments.

Aristotle's syllogism

Deductive reasoning is based on the syllogism, which was the great contribution of the Greek philosopher, Aristotle, to formal logic. In its simplest form, the syllogism consists of a major premise based on a priori or self-evident proposition, a minor premise providing a particular instance, and a conclusion (also referred to in Unit-1). To use a simple example, consider the following proposition:

All planets orbit the sun (Major premise)

The earth is a planet (Minor premise)

Therefore, the earth orbits the sun (Conclusion).

The assumption underlying the syllogism is that through a sequence of formal steps of logic, from the general to the particular, a valid conclusion can be deduced from a valid premise.

In personal and professional life we very often use deductive logic in solving problems. Lawyers, doctors, soldiers, detectives often resort to deductive argument in their professional work. Research workers have been invariably using deductive reasoning to carry out certain tasks of their research work. Without deduction, facts obtained through observation and experiment would be fruitless since one could not fit them into deductive systems called sciences.

Limitations of deductive reasoning

Deductive reasoning has obviously its own limitation. Deductive conclusion depends upon pre-existing knowledge; it does not enable scholars to gain new knowledge or to make new discoveries. Deductive reasoning stresses on the forms of argument and not on the truth or falsity of the statements. According to the deductive mode of reasoning if the form of argument is sound, then even a false premise will not matter. Of course, this does not mean that deductive reasoning has no role in the knowledge generation process. Rather it has its own use in formulating and proposing hypotheses from the general truth (theory), this helps knowledge generation through enquiry by the use of hypothesizing. Deductive reasoning can systematize what is already known and can identify new relationships as one proceeds from known to unknown, but it cannot be relied upon as a self sufficient method for securing reliable knowledge.

2.3.5 Inductive Reasoning

We know that the conclusions reached by deductive reasoning are true only if they are derived from true premises. But the question is how to determine whether the premises are true. Inductive reasoning has been devised to complement deductive reasoning as a means of searching for knowledge. Particular instances (concrete facts) are observed in inductive reasoning and by examining these particular instances, a general conclusion is established about the whole class to which these particular instances belong. These general conclusions, arrived at through induction, may be used as major premises for deductive inferences.

Baconian induction

In the early 1600's, Francis Bacon introduced the mode of inductive reasoning. He felt strongly that deductive mode of reasoning could never suffice for discovery of truth because it started with a preconceived notion and, therefore, biased the results obtained. He declared that if one collected enough data without any preconceived idea about their significance and orientation, one is maintaining complete objectivity

about their significance and orientation, one could maintain complete objectivity about their significance and orientation, one could maintain complete objectivity about the process. Then, Bacon held, it was most likely that an inherent relationship — would emerge.

There may be two forms of induction – **perfect** and **imperfect**. Perfect induction establishes a conclusion by an exhaustive enumeration of all instances that are subsumable under a given class. All India Census operation is an example. Imperfect induction arrived at a generalization by observing only some instances, an adequate and representative sample from the entire class. The researchers in education and other social sciences utilize imperfect induction more often than perfect induction, for in most investigations it may not be possible to examine all the instances to which a conclusion refers.

Bacon's contribution to scientific progress is significant. He realized that advancement of knowledge was not possible only through deductive method. Increasing stress was to be laid on the observational basis of science. Bacon directed the attention of scientists to nature for solutions to peoples' problems, demanding empirical evidence for verification. Logic and authority in themselves were no longer regarded as conclusive means of proof and instead became sources of hypotheses about the world and its phenomena.

Limitations of inductive reasoning

Inductive reasoning has inherent limitations. Just as in the case of deductive reasoning, inductive reasoning also, only by itself, does not lead to much advancement of knowledge. Its basic limitation is that it can be applied to only as many events as can be observed, and hence the conclusions arrived at cannot really be infallible. The conclusions reached by imperfect inductive reasoning do contain information that is not present, even implicitly, in one of the premises (the observed instances). If all the premises (observed instances) are true, the probability of conclusions arrived at may be of varying degrees.

Check Your Progress

Notes: a) Space is given below for writing your answers.

b) Compare your answers with those given at the end of the unit.

1. List the sources of knowledge.

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2. What is syllogism?

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2.4 SCIENTIFIC METHOD

Francis Bacon planted the seeds of the modern scientific method of acquiring knowledge. He recommended that investigators reach conclusions on the basis of observed facts. In order to construct a more practical method of attaining reliable knowledge, scholars like Newton, Galileo, and their successors eventually combined

the deductive and inductive thought processes. This synthesis of reason and observation gave rise to the modern scientific method of generating knowledge.

2.4.1 Defining Scientific Method

If the most distinctive feature of science is its empirical nature, the next most important characteristic is its set of procedures which show not only how findings have been arrived at, but are sufficiently clear for others who are interested to repeat them, i.e. to check them out with the same or other materials and thereby test the result. A scientific approach necessarily involves standards and procedures for demonstrating the empirical warrant of its findings, showing the match or fit between its statements and what is happening or has happened in the world. These standards and procedures, taken together, form the scientific method. Thus, the scientific method is the way in which one can test opinions, impressions or guesses by examining the available evidence both for and against. It is simply the pursuit of truth, which is determined by logical considerations.

We see that the scientific method aims at discovering facts. But facts cannot be discovered without some reflective thinking and enquiry. When using the scientific method, man engages himself in a thinking process called 'reflective thinking'. Every fact is initially nothing but some proposition or problem. John Dewey in 'How We Think' analyzed the stages of the activity involved in the process of reflective thinking in the following five steps:

1. A felt difficulty – When one encounters a puzzling experience or problem.
2. Location and definition of the difficulty – when one makes observations, gathers facts, to specify the difficulty more concretely and precisely.
3. Suggested solutions of the problem or hypothesizing – when one, after a preliminary study of the facts about the problem, makes intelligent guesses about the possible solutions of the problem, which are called hypotheses.
4. Deductive reasoning - one formulates the consequences of the suggested solutions (hypotheses).
5. Testing the hypotheses – when one makes observations or collects evidences to confirm or disconfirm the hypotheses.

Here is how Kerlinger gives a graphic description of the above stages of the scientific method:

First, there is a doubt, a barrier, an indeterminate situation crying out so to speak, to be made determinate. The scientist experiences vague doubts, emotional disturbances, incoherent ideas. He struggles to formulate the problem, even if inadequately. He studies the literature, scans his own experience and the experience of others. Often he simply has to wait for an inventive leap of mind. May be it will occur; may be not. With the problem formulated, with the basic question or questions properly asked, the rest is much easier. Then the hypothesis is constructed, after which its implications are deduced. In this process the original problem, and of course the original hypotheses, may be changed. It may be broadened or narrowed. It may even be abandoned. Last, but not final, the relation expressed by the hypothesis is tested by observation and experimentation. On the basis of the research evidence, the hypothesis is accepted or rejected, this information is then fed back to the original problem and it is kept or altered as dictated by the evidence. What is important to note is the overall fundamental idea of the scientific method as a controlled rational process of reflective enquiry, the interdependent nature of the parts of the process, and the paramount importance of the problem and its statement.

2.4.2 Scientific Method combines Induction and Deduction

The steps in the act of reflective thinking as delineated in the previous section, reveal how induction and deduction serve as opposing processes of the total problem solving

act. Induction provides the ground work for hypotheses, and deduction explores the logical consequences of the hypotheses, in order to eliminate those that are inconsistent with facts, while induction again contributes to the verification of the remaining hypotheses. Thus, in an investigation, one continually shifts between collecting facts, making generalization (hypotheses) to explain facts, deducing the consequences of one's hypotheses, and seeking additional facts to test the hypotheses. By combining both induction and deduction, one is able to arrive at reliable knowledge.

It must be borne in mind that these steps of scientific method do not provide a rigid pattern into which scientists must mould their thinking, for thinking cannot simply be scheduled. Investigators rarely follow a prescribed sequence of procedure. Knowledge generation is often a confused, floundering process rather than a well-shaped logical, orderly one. In an investigation, one does not tackle one step at a time, completes that process, and then moves on to the next step. One may tackle the steps out of order, shuffle back and forth between steps, or work on two steps more or less simultaneously. Some steps may require little effort; other steps may take a disproportionate amount of time and effort.

What is most important to remember is that the scientific method is characterized by an inherent logic of its steps and procedures, which enables an investigator to pin his faith on it as a reliable tool for attaining truth and generating knowledge.

Limitations of scientific method

- It has to be appreciated that the scientific method does not consist merely of the application of the steps such as problem definition, hypothesizing collection of evidence, inferring and testing or verifying, but certain other factors like intuition, imagination, and chance have an undeniable role to play in any process of enquiry. In the history of scientific enquiry there is no dearth of examples to support this view.
- In respect of methodology for explorations of fields yet unknown, the limitation of the scientific method becomes obvious if one recognizes that it represents only a reconstructed logic and not logic-in-use as far as scientific explorations are concerned. According to Kaplan, a reconstructed logic is not a description but rather an idealization of scientific practice. Not even the greatest of scientists has a cognitive style, which is wholly and perfectly logical, and the most brilliant piece of research still betrays its all-too-human divagations. The logic-in-use is embedded in a matrix of an alogic-in-use, even an illogic-in-use. The reconstruction idealises the logic of science.
- Another argument made in adopting the scientific method is that it is only the outcome of applying the scientific method that can be considered as valid knowledge regarding the educational phenomenon. This methodological orthodoxy obviously raises more fundamental epistemological questions as to the role of empirical facts and experiences as tools of acquiring knowledge. Perhaps, an educational researcher needs to examine the underlying assumptions before wedding himself to the method he adopts. This is because the interpretation that a researcher would provide, even for his empirical findings, depends finally upon the philosophical and ideological position he takes.
- One cannot but observe that the situation presents a misconstrued notion that the law of scientific method has already been formulated and it remains for the researcher only to pick out a problem and apply it. This tendency puts a serious methodological limitation to educational research.

It encourages a view in which new methods or new ways of doing research would invariably be looked at with suspicion and hostility, eventually, it blocks attempts to create and invent new methods and techniques which become necessary with the

recognition of the fact that educational problems intrinsically vary from other fields of study such as physical and natural sciences.

Check Your Progress

Notes: a) Space is given below for writing your answers.

b) Compare your answers with those given at the end of the unit..

3. Define the scientific method.

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4. List steps of scientific method.

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2.5 LET US SUM UP

In this unit we have understood that there are several means of generating and acquiring knowledge, viz. experiences, authority, customs and tradition, Deductive and inductive reasoning, and the scientific method. We have noted that all these means have developed historically over time and each one has its own limitations as a source of generating knowledge. We have also seen that the scientific method combines inductive and deductive methods of reasoning, and hence its efficacy as a means of acquiring knowledge.

2.6 UNIT-END ACTIVITIES

1. Interview some senior students of a school and college to know from them what they learnt from following the customary and traditional practices like dressing, particular ways of behaving with children, peers and superiors. Analyze the content of the interview and bring out 'Customs and Traditions' as a source of acquiring knowledge in life.
2. Talk to some researchers in education and try to find out how they came upon their problems of research and how they attempted to systematically plan to study their problems. Analyze the content of your 'talk' and try to carve out the structure of the scientific method employed by the researchers in studying and solving their problems.

2.7 POINTS FOR DISCUSSION

1. Group discussions may be held on the following topics:
   a) Life experience is a better source of acquiring knowledge than inductive and deductive reasoning.
   b) Is the scientific method the best means of acquiring knowledge?
   c) In modern days has the utility of 'Authority' as a means of knowledge generation been much reduced?

2.8 SUGGESTED READINGS

- Dewey John (1933): *How We Think*? Boston: D.C. Heath and Co.
- Cohen, Louis & Manion, Lawrence (1994*): Research Methods in Education.* Fourth Edition, New York: Routledge.
- Van Dalen, Deobold B. (1979): *Understanding Educational Research.* New York: McGraw Hill Book Company.
- Kaplan, Abraham (1969): *The Conduct of Enquiry: Methodology for Behavioural Science.* San Francisco: Chandler Publishing Company.

2.9 ANSWERS TO CHECK YOUR PROGRESS

1. Various sources of knowledge are:
   - Life experiences
   - Authority
   - Customs and tradition
   - Deductive reasoning
   - Inductive reasoning
   - Scientific method
2. A Syllogism can be described as a thinking process in which one proceeds from general to specific statements by deductive thinking. It provides a means of testing the validity of any given conclusion or idea by proceeding from known to unknown.
3. The Scientific method is a back-and-forth movement of thought in which man first operates inductively from partially known or sometimes confused information learned from experience, previous knowledge, observation and so on towards a meaningful whole or hypothesis, and then deductively from suggested whole or hypothesis to the particular parts in order to connect these with one another in a meaningful pattern to find relationships.
4. The five important steps of scientific method are:
   i) Identification and definition of the problem.
   ii) Formulation of a hypothesis.
   iii) Testing and implication of hypothesis through deductive reasoning.
   iv) Collection and analysis of evidences (data).
   v) Verification, rejection, or modification of hypothesis.