CHAPTER 5

METHODOLOGY

Introduction

Methodology is a broad term that refers to the general logic and theoretical perspective for conducting research. It refers to the blueprint or set of decisions and procedures that governs a study and renders it understandable to others and is subject to inquiry, critique and replication or adaptation to other settings (Schensul, 2012). The term „method" used in research refers to the techniques used for research such as surveys, interviews, observations, etc. Methodology of research consists of the process adopted by the researcher to conduct the study and to arrive at the conclusion of the problem framed. As research is a scientific and systematic process, it has to adopt certain steps or process to claim some conclusion. Research methodology describes various steps of the plan which are adopted for solving the research problem at hand. It includes the way of formulating the problems, the definition of terms, the choice of subjects for investigation, the validation of data gathering tools, the collection, analysis and interpretation of data, and the processes of inferences and generalization.

The selection of methodology depends on the type of study conducted. The methods selected should be in consensus with scientific principles and adequate enough to lead to dependable generalization. To select an appropriate method, the researcher must have a thorough understanding of all research methods with particular reference to their strengths, limitations, applicability and appropriateness. A pre-planned and well-described method provides the researcher a scientific and feasible plan for attacking and solving the problem under investigation.

According to Good, Barr and Scates (Good, 1941), methods of research may be classified from many points of view—

- The field to which applied: education, history, philosophy, psychology, biology
- Purpose: description, predict, determination of causes, determination of status
- Place where it is conducted: in field, in laboratory
- Application: pure research, applied research

- Data gathering devices employed: tests, rating scale, questionnaire
- Nature of data collected: objective, subjective, quantitative, qualitative
- Forms of thinking: deductive, inductive
- Control of factors: controlled setting, natural setting

However, these divisions are not water-tight compartments. Many of these overlap with each other. Therefore, there are some basic divisions for the convenience of the researchers. Some of these are—

Historical, Descriptive and Experimental Research

(1) Historical Method—This method is involved when the field of study is historical, i.e. related to past events. It is used to discover, describe and interpret what existed in the past. Historical research attempts to establish facts so as to arrive at conclusions concerning past events. Its main purpose is to arrive at an accurate account of the past to gain a clearer perspective of the present. In the field of education it is necessary to know and understand educational achievements and trends of the past in order to gain insights into the present and future directions.

(2) Descriptive Method— Descriptive research method is used to obtain significant and precise information concerning the current status of phenomena and to draw valid general conclusions from the facts discovered. It is a method of investigation to study, describe and interpret what exists at present. It often results in formulation of important principles of knowledge and solution of significant problems. Descriptive research can be either quantitative or qualitative depending on the nature of data collected. It involves gathering data that describe events and then organizes, tabulates, depicts and describes the data collection. When in-depth, narrative descriptions of small numbers of cases are involved, description is used as a tool to organize data into patterns that emerge during analysis. These patterns aid the mind in comprehending a qualitative study and its implications. The description often illuminates knowledge that might not be otherwise noticed. In the field of education, it helps to explain educational phenomena in terms of the conditions or relationships that exists, opinions that are held by the

students, teachers, parents and experts, ongoing processes, effects that are evident, or trends that are developing.

(3) Experimental Method—This method of investigation is used to derive basic relationships among phenomena under controlled conditions or, more simply, to identify the conditions underlying the occurrence of a given phenomenon. Experimental method provides for control of the variables under study. It establishes a systematic and logical association between manipulated factors and observed effects. The essential characteristics of experimental research are control, manipulation, observation and replication.

Fundamental, Applied and Action Research

On the basis of the purpose or objectives, research can be classified as—fundamental, applied and action research.

(1) Fundamental research—The research which aims at the formulation of a theory or a contribution to the existing body of knowledge is fundamental research. Its major aim is to obtain and use the empirical data to formulate, expand or evaluate theory. It employs a rigorous and structured type of analysis and careful sampling procedures. So, its findings may be extended beyond the group or situation and theories are developed by discovering proved generalizations or principles. The main aim of fundamental research is the discovery of knowledge for the sake of knowledge.

(2) Applied research—The research which aims at solution of immediate, specific, and practical problems by applying the existing theories or knowledge is applied research. It is performed in relation to actual problems and under the conditions in which they are found in practice. Adding scientific knowledge is only a secondary goal of applied research. It places importance on solving a problem at hand. They are generalizable to the extent that the population is similar to the sample of the research.

(3) Action research—Action research is research on an immediate problem. The main aim of action research is to solve any contextual problem. Its results cannot be generalized. It is done on a specific problem on a very small sample, sometimes on the whole population within a short period of time. Trained

researchers are not required for conducting action research. It is mostly done by the people involved in the process.

Quantitative and Qualitative Research

Another division may be on the basis of the nature of data collected and their analysis. Research methods in social sciences, particularly in education, are often divided into two main types: quantitative and qualitative methods. Early forms of research originated in the natural sciences which observed and measured in some way in order to gain understanding. Quantitative research refers to observations and measurements that can be made objectively and repeated by other researchers. With the development of social sciences, people were interested in studying human behavior and the social world. The social sciences found it difficult to measure human behavior in the simpler quantitative methods, therefore qualitative research methods were developed in order to look beyond how, how often and how many. It looks at why and attempts to further and deepen our understanding of the social world. Quantitative researchers aim for a disciplined objectivity in their attitude towards subject and their collection and treatment of data. While qualitative researchers aim for a disciplined subjectivity that embraces even as it makes explicit the partiality inherent in all inquiry (Sandelowski, 2004). The quantitative research emphasizes on the control of research conditions to minimize bias and threats to the validity of findings, and commitment to a research design developed prior to entering the field of study. In contrast, qualitative research emphasizes on observing events as they unfold without manipulating any conditions and the ongoing development and refinement of research design after entering the field of study.

Quantitative Research

Quantitative research is most relevant in natural sciences. However, it is also used in social sciences where numerical data are concerned. It is conducted when the data is in numerical form and the study demands for quantitative analysis of the data. Quantitative research aims to classify features, count them, construct statistical models and attempt to explain what is observed. The raw data collected from the selected sample are organized, classified, tabulated, analyzed and interpreted for drawing conclusions and generalizations. Organization of data includes editing, classifying and tabulating quantitative information while editing implies checking of the gathered raw data for accuracy, usefulness and completeness. Classification refers to dividing of the data into different categories, classes, groups or heads. Tabulation is the process of transferring classified data from data-gathering tools to the tabular form. It helps in systematic examination of the data. Analysis of data means studying the organized material leading to discover inherent facts. Aliaga and Gunderson (2002) describe quantitative research methods as “explaining phenomena by collecting numerical data that are analyzed using mathematically based methods (in particular statistics)”. Here, „explaining phenomena‟ is a key element of all research, be it quantitative or qualitative. The specificity of quantitative research lies in the „collection of numerical data‟. And therefore requires „mathematically based methods‟ for analysis. Some data do not naturally appear in quantitative form. However, they can be collected in a quantitative way by designing research instruments aimed specifically at converting phenomena that don‟t naturally exist in quantitative form into quantitative data, which can be analyzed statistically.

Strengths

1. Quantitative research tests and validates already constructed theories about how and why phenomena occur.
2. Quantitative data is more efficient and able to test hypotheses.
3. Research findings can be generalized when the data are based on random samples of sufficient size and when it has been replicated on many different populations.
4. The researcher may construct a situation that eliminates the confounding influence of many variables, allowing one to more credibly establish cause-and-effect relationships.
5. Data collection using some quantitative methods is relatively quick.
6. It provides precise, quantitative and numerical data.
7. Data analysis is relatively less time consuming (using statistical software).
8. The research results are relatively independent of the researcher (e.g., statistical significance).

Weaknesses

1. The researcher‟s categories that are used might not reflect local constituencies‟ understandings.

2. The researcher‟s theories that are used might not reflect local constituencies‟ understandings.
3. The researcher might miss out on phenomena occurring because of the focus on theory or hypothesis testing rather than on theory or hypothesis generation.
4. Knowledge produced might be too abstract and general for direct application to specific local situations, contexts, and individuals.

Qualitative Research

Qualitative researches are mostly conducted in the behavioral sciences. Some fields like education, pedagogy, psychology, etc. deal directly with the human behavior. This leads to a debate on the relative merits of adopting either quantitative or qualitative methods in these fields. Now-a-days, qualitative methods are being increasingly used in the social sciences. The utility of qualitative methods has also been recognized in psychology.

The characteristic feature of qualitative research is that it seeks out the „why‟, not the „how‟ of its topic through analysis of unstructured information available to a researcher. The unstructured information may be in the form of interview transcripts, content analysis, open ended survey response, etc. The data collected in such researches are mostly in verbal and other symbolic form. The data indicate what people have said or written in their own words about their experiences and interactions in natural settings. After analysis, the data provide useful and in depth answers to the research questions. Analysis of qualitative data involves studying the organized material in order to discover inherent facts. The collected data are studied from as many angles as possible either to explore new facts or to reinterpret already known existing facts. The methods of content analysis, inductive analysis and logical analysis are mostly used in analysis of qualitative materials.

Qualitative research is an umbrella term for an array of attitudes toward and strategies for conducting inquiry that are aimed at discerning how human beings understand, experience, interpret and produce the social world (Mason, 1996). However, qualitative research is not the domicile of a particular discipline but used by researchers from the sciences, humanities and practice disciplines, committed to different philosophical and methodological positions. These philosophical positions include interpretivism, hermeneutics, social constructionism, critical theory, etc.

Qualitative research is an effort to produce rich, relevant and detailed descriptions and particularized interpretations of people and the social, linguistic, material, and other practices and events that shape and are shaped by them. It is a form of purposive sampling for information-rich cases, in depth interviews and open-ended interviews, lengthy participant or field observations, and/or document or artifact study. It involves techniques for analysis and interpretation of data that move beyond the data generated and their surface appearances. Qualitative research is typically directed toward producing idiographic (concerned with the detailed understanding of particular circumstances, phenomena, events, or cases) knowledge. It is also characterized by a diverse array of orientations to and strategies for maximizing the validity or trustworthiness of study procedures and results. The features of qualitative research may be outlined as—

(i) The focus is essentially on what things mean, that is, why events occur as well as what happens.

(ii) In qualitative research, the emphasis is on the process.

(iii) Data analysis in qualitative studies emphasizes inductive methods.

(iv) The study involving qualitative methods is primarily aimed to describe and only secondarily to analyze the events and things occurring in the natural setting.

(v) Only the researcher is supposed to make sense of the data through his own elucidation and interpretation of the information collected. So, it is also known as interpretative research.

Strengths

1. Qualitative research results in more in depth information.
2. Qualitative research is low cost. Because it requires a smaller scale, large surveys don't need to be taken.

Weaknesses

1. Qualitative research is relatively subjective and therefore less generalizable.
2. It is time consuming.

Data Analysis in Qualitative Research

Qualitative data analysis is mostly used in the field of social and behavioral sciences. To quote Michael Quinn Patton (Patton, 2002), “Qualitative analysis transforms data into findings. No formula exists for that transformation. Direction can and will be offered, but the final destination remains unique for each inquirer, known only when—and if—arrived at”. The focus on text—on qualitative data rather than on numbers—is the most important feature of qualitative analysis. The data that qualitative researchers analyze may be transcripts of interviews or notes from participant observation sessions, pictures or other images or some kind of contents that the researcher examines. The qualitative analysts may have two different goals—analyzing the data to go beyond the numbers recorded in a quantitative analysis and adopting a hermeneutic perspective on texts (an interpretation that cannot be judged true or false). Qualitative data analysis tends to be inductive—the researcher identifies important categories in the data, as well as patterns and relationships, through a process of discovery. There are often no predefined measures or hypotheses.

Qualitative data analysis is a repetitive and reflexive process that continues throughout the process of data collection. The researcher notes down the ideas about the meaning of the text and how it might relate to other issues. They adjust the data collection process itself when it begins to appear that additional concepts need to be investigated or new relationships explored. This process is known as progressive focusing (Parlett & Hamilton, 1976).

Qualitative data are analysed through interpretive and coding techniques. The simplest analysis of qualitative data is observer impression. The observers examine the data, interpret it via forming an impression and report their impression. Coding is an interpretive technique that seeks to both organize the data and provide a means to introduce the interpretations of it into certain quantitative methods. The researcher read the data and demarcate segments within it. Each segment is labeled with a code (usually a word or short phrase) that suggests how the associated data segments inform the research objectives. There are different methods of data analysis used in qualitative research—

(i) *Typology*: Creation of a system of classification, list of (mutually exclusive) categories.

(ii) *Taxonomy*: Essentially a typology with multiple levels of concepts.

(iii) *Grounded Theory (Constant Comparison)*: Coding of documents, categories saturate when no new codes are added to them; core/axial categories emerge.

(iv) *Induction*: Form hypothesis about event, then compare to similar event to verify/falsify/modify hypothesis. Eventually central/general hypothesis will emerge.

(v) *Matrix/Logical Analysis*: Predominantly Use flow charts, diagrams.

(vi) *Quantitative/Quasi-Statistics*: Count numbers of events/mentionings, mainly used to support categories.

(vii) *Event (Frame) Analysis*: Identify specific boundaries (start,end) of events, then event phases.

(viii) *Metaphorical Analysis*: Develop specific metaphors for event, also by asking participants for spontaneous metaphors/comparisons.

(ix) *Domain Analysis*: Focus on cultural context, dscribe social situation and cultural patterns within it, semantic relationships.

(x) *Hermeneutical Analysis*: Meaning of event/text in context (historical, social, cultural etc.).

(xi) *Discourse Analysis*: Ongoing flow of communication between several individuals; identify patterns (incl. temporal, interaction)

(xii) *Semiotics*: Meaning exists in context alone; identify specific meaning in connection with concrete context

(xiii) *Content Analysis*: Identify themes/topics, find latent themes/emphases. Generally rule-driven (e.g. size of data chunks).

(xiv) *Phenomenology/Heuristic*: Idiosyncratic meaning to individual, potentially focused mainly on the reseracher‟s own experience/reception of the event

(xv) *Narratology*: Study of the intrinsic structures of how a story is told/text is written.

Here we will discuss only the methods relevant for the present study, i.e. content analysis, meta analysis, hermeneutical analysis and psychoanalysis.

Qualitative Content Analysis

Among the earliest definition of content analysis are the following: “the technique known as content analysis…attempts to characterize the meanings in a given body of discourse in a systematic and quantitative fashion." (Kaplan, 1943) Another definition goes as "content analysis is a research technique for the objective, systematic and quantitative description of the manifest content of communication" (Berelson, 1954). However, later definitions abandoned the requirement of quantification. Emphasis shifted to inference, objectivity and systematization. Whether quantitative or simply inferential, content analysis approaches the study of text as a scientific, rather than simply interpretative activity.

Qualitative content analysis examines significant aspects of texts that are not amenable to quantitative techniques. Such techniques measure patterns of frequency and regularity in a large number of texts, but the most significant part of the text may resist quantification. Even where this is not the case, some aspects of a text cannot be counted easily, and when they can be, this may tell very little of how they operate within or across texts. Examples of textual features and functions resistant to quantification include irony, ambivalence and allusion; communicative register and mode of address; folkloric motifs, aesthetic codes, and generic conventions; rhetorical and stylistic devices, including resonant metaphors and other figures of speech; and the point of view, presuppositions, and values that may come implicitly with the message and make certain categories or notions appear natural or absolute in meaning. Qualitative content analysis begins at the point where statistical presentation reaches its limits. It reveals the significance of textual features that are latent or hidden in the content or that have consequences beyond their immediate meaning.

Qualitative Meta-analysis

A meta-analysis is a type of data analysis, in which the results of several studies are lumped together and analyzed as if they were the results of one large study. It combines the results of several studies that address a set of related research hypotheses. This method was proposed by Gene Glass in 1976 to integrate and summarize the findings from a body of research.

Meta-analysis attempts to bring the precision and reliability of experimental methodology to the task of reviewing and synthesizing groups of studies. The basic procedure in meta-analysis is to define a set of questions that the analysis will address and develop a scheme for coding each relevant study in the literature. Statistical methods exist for combining the results of several different experiments addressing the same issue and taking the experimental designs, the magnitude of effects, and other factors into account. The power of meta-analysis lies not only in statistical comparison, however, but also in coding schemes that permit quantitative answers to questions about groups of studies.

Qualitative meta-analysis is a distinctive category of synthesis in which the findings from completed qualitative studies in a target area are formally combined. Both an analytic process and an interpretative product, qualitative meta-analysis is analogous to quantitative meta-analysis in its intent to ascertain systematically, comprehensively, and transparently the state of knowledge in a field of study. Owing in part to the early stage of its development as a research method, qualitative meta-analysis has been variously portrayed as a form of, encompassed by, or synonymous with other kinds of qualitative synthesis, such as grounded theory, meta-study, and secondary analysis of qualitative data.

Hermeneutical analysis

The term „hermeneutics" is derived from the Greek word *'hermeneutice'*, which tells about its root to the ancient Greek philosophy. The literal meaning of hermeneutics is "making the obscure plain". But generally, it is translated as "to interpret" or "to understand". Traditionally, hermeneutics was a method of biblical interpretation which emerged in 17th century in Germany. (Blaikie, 2004) Later philosophers and theorists moulded it into a field which describes a set of rules that provide the basis for good interpretive practice for any subject matter. Apart from the Bible, it was also applied to other texts, particularly those that are obscure, alien or symbolic. The aim is to reveal the meaning and intentions that are hidden in the text. Sometimes even such meanings are included of which even the author may not have been aware. Wilhelm Dilthey further broadened hermeneutics, taking it as the methodology for the recovery of meaning that is essential to understand within the „human" or „historical" sciences. In the context of social research, hermeneutics is concerned with the interpretation of meaningful human action.

There are two extreme views regarding hermeneutics on the basis of the objectivity of interpretation. One looked to hermeneutics for general methodological principles of interpretation. It endeavored to establish an objective understanding of history and social life above and outside of human existence. Schleirmacher proclaimed that "hermeneutics deals only with the art of understanding, not with the presentation of what has been understood." (Gallagher, 1992). The other view regarded hermeneutics as a philosophical exploration of the nature and requirements for all understanding. This view regarded objectively valid interpretation as being impossible. The factors that may influence the interpretation of a text are—

(i) act of reading
(ii) the situation of the reader
(iii) the structure of the text
(iv) the author
(v) the situation of the author

Psycho-analysis

Psychoanalysis is both a clinical psychotherapeutic practice and a body of theory concerning people‟s mental life, including its development and expression in activities and relationships. Empirical findings are basic to psycho analysis, but rather than being based on a claim to objectivity, these findings are recognized to be the product of both the patient‟s and analyst‟s subjectivities. The scientific status of psycho-analytic method is objected because they are based on consulting rooms and not in laboratories. Moreover, it produces single case studies and not generalizable findings. However, following the challenge to positivist methods in social science research, the resulting linguistic, qualitative, and hermeneutic turns have opened a scope for psychoanalysis in qualitative methods. Psychoanalytic method require modification if extended beyond the consulting room, where research findings are subordinate to therapeutic purpose (Hollway, 2004). Thus psychoanalytic interpretation has applications both in clinical and research context. But other methods of validation are sought in generating and interpreting research data psychoanalytically.

External and Internal Criticism

In qualitative research, the validity of the research is a big question. Therefore, the researcher has to adopt a critical point of view while carrying out qualitative study. It has two main threats—the genuineness of the data and the accuracy of the data. These are known as external and internal criticism respectively.

External criticism establishes the authenticity and genuineness of the data collected. It helps the researcher to determine whether it is what it appears or claims to be and whether it reads true to be original so as to save the researcher from being the victim of a fraud. In historical study, the researcher does this by thoroughly examining the signature, handwriting, script, language, documentation and knowledge available at that period.

Internal criticism establishes the accuracy and trustworthiness of the contents of the evidences. External criticism reveals only the genuineness of the data but internal criticism reveals whether or not these data reflect a true picture. Internal criticism also aims to establish the credibility of the author of the documents. The researcher has to ascertain whether the authors were honest, unbiased and actually acquainted with the facts or whether they were themselves biased or too sympathetic or too antagonistic to a true picture. Internal criticism may be positive or negative. It is positive when the researcher seeks to discover the literal and the real meaning of the text and negative when the researcher tries to seek every possible reason for disbelieving the statement made, questioning critically the competence, truthfulness or accuracy, and honesty of the author.

In the present study, the researcher mostly used secondary data and proper reference of every data has been given for further consultation. However, the researcher has presented her own interpretation of the data in many cases.

Primary sources and Secondary sources

The data which are collected directly from the field under the control and supervision of an investigator is known as primary data. A primary source is a document or other sort of evidence written or created during the time under study. Primary sources offer an inside view of a particular event. The original documents or remains come under the category of primary sources. They are available in written, pictorial or mechanical forms. It includes—original documents (diaries, speeches, letters, minutes, interviews, news, film footage, autobiographies, official records, scholarly journal articles reporting new research or findings); creative works (poetry, drama, novels, music, art); relics or artifacts (jewelry, pottery, furniture, clothing, buildings); mechanical records (photographs records of events and tape recordings of interviews, meetings, speeches); oral testimony of traditions and events (myths, folk tales, ceremonies), etc.

Secondary data are collected from sources which have been already created for the purpose of first-time use and future uses. The data collected from journals, magazines, government publications, annual reports, etc. are secondary data and such sources are secondary sources. A secondary source interprets and analyzes primary sources. Secondary sources are one step away from the event. It includes—documents (textbooks, magazine articles, histories, criticism, commentaries, encyclopedias, systematic reviews, meta-analyses).

However, the distinction between primary data and secondary data is only relative. The primary data of one study may serve as secondary data of another study.

Research in Education and Cognitive Science

In education, research is conducted with an attempt to gain better understanding of the educational process in order to make it more efficient. Researches in education mostly use the research methods of behavioral sciences. Since education is a behavioral science, the major concern of educational science is to understand, explain, and to some degree predict and control human behavior. Physical sciences are more quantitative as far as their units and measurements are concerned. But social sciences and behavioral sciences generally adopt qualitative methods of research. From the literature that have been reviewed for the present study, it is observed that most of the studies have adopted the experimental design in their study (Srivastava, 2009; Baijal, 2010; Prasad, 1979; Nandanpawar, 1986; Amin, 1988; King, 1994; Clump, 2005; Rittle-Johnson & Star, 2007; Gadgil & Nokes-Malach, 2011; Richland et al, 2005; Simone, 2008; Booth & Koedinger, 2011, Basantia & Panda, 2010).

As cognitive science is a mixture of varied disciplines, it has at its disposal a very wide and varied pool of methods, ranging from computer simulation to naturalistic observation, from recording the electrical impulses of the brain to performing linguistic analyses, from using non-monotonic logics to collecting reaction times or verbal protocols. Moreover, content analysis and meta-analysis constitute potentially useful methods not yet widely used in cognitive science.

Methodology adopted in the present study

As there are no quantitative data, for the present study, qualitative methodology is adopted keeping in view the objectives of the study. The basic objective of the research is to study the newly emerged field of cognitive science and draw out its implications on pedagogical practices. Therefore, qualitative methods like content analysis, meta-analysis and hermeneutical analysis are used. Meta-analysis as a method of study has been adopted for the present study, particularly keeping in view its interdisciplinary nature.

Sources used: In the present study, the researcher has used documents as her primary sources. The primary sources include books and encyclopedias on cognitive science collected mostly from the National Library, Kolkata and some from Centre for Behavioural and Cognitive Studies, Allahabad University; School of Cognitive Science, Jadavpur University; American Library, Kolkata and internet. It also includes different syllabi of educational psychology and cognitive science of masters‟ level. Moreover, the researcher has used many theses and journal articles (both online and printed) related to the topic for meta-analyses. The secondary sources include books and encyclopedias on philosophy, psychology, cognitive psychology, etc.

Methods adopted: The researcher used the method of content analysis for the first, second and third objectives of the study, i.e. studying the history of cognitive science, cognitive science in Indian perspective and components of cognitive science. The history of cognitive science was traced back from its philosophical roots by analyzing its epistemological roots. A thorough description of its history has been presented from its epistemological origin till date. For the second objective, the essence of cognitive science was traced in the Indian philosophical and psychological literature. To gain insight into the components of cognitive science, the researcher has used the encyclopedias and the classic books on cognitive science like Barbara Von Eckdart‟s „What is Cogntive Science‟, Rom Harre‟s „Cognitive Science—A Philosophical Introduction‟, G. C. Gupta‟s „Cognitive Science—Issues and Perspectives‟, M. I. Posner‟s „Foundations of Cognitive Science‟, etc. and the syllabi of cognitive science programmes in different institutions in India. For the fourth objective, that is, to study the components of cognitive science used in the field of education, the researcher analyzed the syllabi of cognitive science programmes in different institutions in India and the syllabi of educational psychology at post-graduate programmes. For the fifth and sixth objectives, content analysis, meta-analysis and hermeneutical analysis have been conducted on various relevant research studies and doctoral theses.

The objective-wise use of source and methods are—

1. Objective: To study the historical development of cognitive science as a field of study.
   Sources: Documents (Encyclopedia and various journal articles)
   Methods: Content analysis

2. Objective: To study cognitive science in Indian perspective.
   Sources: Documents
   Methods: Content analysis

3. Objective: To study the various components of cognitive science.
   Sources: Documents (Encyclopedia, syllabi of Cognitive Science programmes at Master"s level)
   Methods: Content analysis

4. Objective: To study the uses of various components of cognitive science in the field of education.
   Sources: Documents (syllabi of educational psychology at M.A. level)
   Methods: Content analysis

5. Objective: To study the problems in practicing these components in the teaching-learning process.
   Sources: Research studies, theses
   Methods: Content analysis, meta-analysis and hermeneutical analysis

6. Objective: To suggest some guidelines for effective use of different components of cognitive science for pedagogical improvement in the field of education.
   Sources: Research studies, theses
   Methods: Content analysis, meta-analysis and hermeneutical analysis.