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MA EDUCATION

MAE 202: EDUCATIONAL RESEARCH

w.e.f Academic Session: 2024-25

CENTRE FOR DISTANCE AND ONLINE EDUCATION

UNIVERSITY OF SCIENCE & TECHNOLOGY MEGHALAYA

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Techno City, 9th Mile, Baridua, Ri-Bhoi, Meghalaya, 793101

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MAE 202

Educational Research

Introduction

Educational research is a systematic inquiry aimed at understanding and improving educational practices and outcomes. This course will equip students with the skills necessary to conduct rigorous research, understand various methodologies, and apply statistical analyses to interpret data effectively. By the end of this course, students will be proficient in designing research studies, formulating hypotheses, and employing appropriate sampling techniques.

Unit 1: Fundamental Basis of Educational Research

This unit introduces the foundational concepts of educational research, exploring its meaning, nature, scope, and purpose. Students will learn about the significance of research in education, how it informs policy, and its role in enhancing teaching and learning processes. The unit will also cover different types of research methods, emphasizing the importance of ethical considerations and critical thinking in conducting educational research.

Unit 2: Research Design

Research design is the blueprint for conducting a study. This unit will guide students through the process of planning and structuring their research projects. Topics include selecting appropriate research methodologies, defining research questions, and determining the most suitable design for various educational contexts. Students will also explore mixed-methods approaches, understanding when and how to combine qualitative and quantitative research techniques.

Unit 3: Variables and Hypotheses

Understanding variables and hypotheses is crucial for conducting meaningful research. This unit delves into the different types of variables, including independent, dependent, and confounding variables, and their roles in research studies. Students will learn how to construct testable hypotheses and understand their significance in guiding research. Emphasis will be placed on the logical relationships between variables and how these relationships can be investigated through empirical research.

Unit 4: Sampling

Sampling is a critical component of research that impacts the validity and reliability of study results. This unit will cover various sampling techniques, including probability and

non-probability sampling methods. Students will learn how to select representative samples, understand the implications of sample size, and mitigate potential biases in their studies. The unit will also address challenges in sampling, such as accessing hard-to-reach populations, and provide strategies for overcoming these obstacles.

Unit 1
Fundamental Basis of Educational Research

Unit Structure

1.0 Learning Objectives

- ✓ Understand the fundamental principles of educational research.
- ✓ Explore the range and areas covered by educational research.
- ✓ Identify the objectives and significance of conducting educational research.
- ✓ Learn about the process and methods of scientific inquiry.
- ✓ Recognize the role and benefits of developing theories in research.
- ✓ Analyze how science, education, and educational research are interconnected.
- ✓ Identify and understand the nature of fundamental research in education.
- ✓ Identify and understand the nature of applied research in education.

- ✓ Identify and understand the nature of action research in educational contexts.
- ✓ Distinguish among fundamental, applied, and action research.
- ✓ Recognize and understand different paradigms within educational research.

1.1 INTRODUCTION

Research enriches human life by improving its quality. It is a quest for knowledge and a methodical way to solve problems scientifically. Research involves a careful inquiry to acquire knowledge, representing a journey from the known to the unknown. It is a systematic effort to gain new insights across various disciplines. When addressing educational issues, it becomes educational research.

Human curiosity and inquisitiveness drive the quest for knowledge and truth. Through trial and error, individuals learn to systematically pursue goals, adapting and developing effective methods for success. This process leads to wisdom and the creation of scientific procedures for future tasks. Thus, a relationship exists among science, education, and educational research.

Research is a "voyage of discovery," seeking answers to unresolved questions. It is essential for developing new theories or modifying existing ones. Throughout history, research has led to numerous discoveries and inventions, providing theories that help solve human problems. Figures like Graham Bell, Thomas Edison, J.C. Bose, John Dewey, B.F. Skinner, and Jean Piaget have contributed theories that promote educational progress. Research requires expertise and dedication to advance knowledge.

1.2 SOURCES OF ACQUIRING KNOWLEDGE

From the time we were born and the present day, each one of us has accumulated a body of knowledge. Curiosity, the desire to learn about one‘s environment and the desire to improve one‘s life through problem-solving is natural to all human beings. For this purpose, human beings depend on several methods / sources of acquiring knowledge as follows:

1. Learned Authority: Human beings refer to an authority such as a teacher, a parent or the boss or an expert or consultant and seek his / her advice. Such an authority may be based on knowledge or experience or both. For example, if a child has difficulty in learning a particular subject, he / she may consult a teacher. Learned authority could also be a book / dictionary / encyclopedia / journal / web-site on internet.

2. Tradition: Human beings easily accept many of the traditions of their culture or forefathers. For example, in matters of food, dress, communications, religion, home remedies for minor ailments, the way a friend will react to an invitation, one relies on family traditions. On the other hand, students, in case of admission criteria and procedures, examination patterns and procedures, methods of maintaining discipline, co-curricular activities, acceptable manner of greeting teachers and peers rely on school traditions. Long established customs or practices are popular sources of acquiring knowledge. This is also known as tenacity which implies holding on to a perspective without any consideration of alternatives.

3. Experience: Our own prior personal experiences in matters of problem-solving or understanding educational phenomena is the most common, familiar and fundamental source of knowledge.

4. Scientific Method: In order to comprehend and accept learning acquired through these sources, we use certain approaches which are as follows:

(a) **Empiricism:** It implies relying on what our senses tell us. Through a combination of hearing and seeing we come to know the sound of a train. i.e. through these two senses, we learn to associate specific sounds with specific objects. Our senses also enable us to compare objects / phenomena / events. They provide us with the means for studying and understanding relationships between various concepts (eg. level of education and income).

(b) **Rationalism:** It includes mental reflection. it places emphasis on ideas rather than material substances. if we see logical interconnectedness between two or more things, we accept those things. For example, we may reason that conducive school / college environment is expected to lead to better teacher performance.

(c) **Fideism:** It implies the use of our beliefs, emotions or gut reactions including religion. We believe in God because our parents told us though we had not sensed God, seen or heard him nor had concluded that that his existence is logically proved.

1.3 MEANING, STEPS AND SCOPE OF EDUCATIONAL RESEARCH

MEANING:

Educational Research as nothing but cleansing of educational Research is nothing but cleansing of educational process. Many experts think Educational Research as following - Mouly "Educational research is the systematic application of the scientific method to solve educational problems."

Travers "Educational research is the activity for developing a science of behavior in educational situations, enabling educators to achieve their goals effectively."

Whitney "Educational research aims to find solutions to educational problems using scientific and philosophical methods."

Thus, Educational Research is to solve educational problem in systematic and scientific manner, it is to understand, explain, predict and control human behaviour.

Educational Research Characterizes as follows:

- It is highly purposeful.
- It deals with educational problems regarding students and teachers as well.
- It is precise, objective, scientific and systematic process of investigation.
- It attempts to organize data quantitatively and qualitatively to arrive at statistical inferences.
- It discovers new facts in new perspective. i. e. It generates new knowledge.
- It is based on some philosophic theory.
- It depends on the researchers ability, ingenuity and experience for its interpretation and conclusions.
- It needs interdisciplinary approach for solving educational problem.
- It demands subjective interpretation and deductive reasoning in some cases.
- It uses classrooms, schools, colleges department of education as the laboratory for conducting researches.

STEPS OF RESEARCH:

The various steps involved in the research process can be summarized as follows

Step 1: Identifying the Gap in Knowledge

The researcher, on the basis of experience and observation realizes that some students in the class do not perform well in the examination. So he / she poses an unanswered question : —Which factors are associated with students‘ academic performance?||

Step 2: Identifying the Antecedent / Causes

On the basis of experience, observation and a review of related literature, he / she realize that students who are either very anxious or not at all anxious do not perform well in the examination. Thus he / she identify anxiety as one of the factors that could be associated with student's academic performance.

Step 3: Stating the Goals

The researcher now states the goals of the study:

1. To ascertain the relationship of anxiety with academic performance of students.

2. To ascertain the gender differences in the anxiety and academic performance of students.

3. To ascertain the gender difference in the relationship of anxiety with academic performance of students.

Step 4: Formulating Hypotheses

The researcher may state his / her hypotheses as follows:

1. There is a significant relationship between anxiety and academic performance of students.

2. There is a significant gender difference in the anxiety and academic performance of students.

3. There is a significant gender difference in the relationship of anxiety with academic performance of students.

Step 5: Collecting Relevant Information

The researcher uses appropriate tools and techniques to measure anxiety and academic performance of students, selects a sample of students and collects data from them.

Step 6: Testing the Hypotheses

He / she now use appropriate statistical techniques to verify and test the hypotheses of the study stated in Step 4.

Step 7: Interpreting the Findings

He / she interpret the findings in terms of whether the relationship between anxiety and academic performance is positive or negative, linear or curvilinear. He / she finds that this relationship is curvilinear i.e. when a student's anxiety is either very low or very high, his / her academic performance is found to be low. But when a student's anxiety is moderate, his

/ her academic performance is found to be high. He / she now tries to explain this finding based on logic and creativity.

Step 8: Comparing the Findings with Prior researchers' Findings

At this step, the researcher tries to find out whether his / her conclusions match those of the prior researches or not. If not, then the researcher attempts to find out why conclusions do not match with other researches by analyzing prior studies further.

Step 9: Modifying Theory

On the basis of steps 7 and 8, the researcher speculates that anxiety alone cannot influence academic performance of students. There could be a third factor which influences the relationship between anxiety and academic performance of students. This third factor could be study habits of students. For instance, students who have very low level of anxiety may have neglected their studies throughout the year and hence their academic performance is poor. On the other hand, students who have very high level of anxiety may not be able to remember what they have learnt or cannot concentrate on studies due to stress or may fall sick very often and hence cannot study properly. Hence their academic performance is poor. However, students with a moderate level of anxiety are motivated enough to study regularly and systematically all through the year and hence their academic performance is high.

Thus, the loosely structured theory on student's academic performance needs to incorporate one more variable, namely, study habits of students. In other words, it needs to be modified.

Step 10: Asking New Questions

Do study habits and anxiety interact with each other and influence academic performance of students? i.e. we can now start with a fresh topic of research involving three variables rather than two.

SCOPE OF EDUCATIONAL RESEARCH:

Name of Educational Research changes with the gradual development occurs with respect to knowledge and technology, so Educational Research needs to extend its horizon. Being scientific study of educational process, it involves:

- Individuals (Student, teachers, educational managers, parents.)
- institutions (Schools, colleges, research – institutes)

It discovers facts and relationship in order to make educational process more effective. It relates social sciences like education.

It includes process like investigation, planning (design) collecting data, processing of data, their analysis, interpretation and drawing inferences.

It covers areas from formal education and conformal education as well.

Thus, educational research is the systematic application of scientific methods to solve educational problems, benefiting both students and teachers. Since the results of democratic education can be slow and sometimes flawed, educational research is essential to address these issues. It involves individuals such as teachers and students and encompasses both formal and non-formal education. Through this research, educational problems are resolved, the educational process is refined, and new knowledge is generated.

Check your Progress

1. What is the aim of Educational Research?
2. Name the method which is mainly applicable in Educational Research?
3. Which approach is adopted in Educational Research?
4. Name the places which can act as lab oratory for conducting Education Research.
5. What does educational research involve?

1.4 SCIENTIFIC METHOD, AIMS AND CHARACTERISTICS OF RESEARCH AS A SCIENTIFIC ACTIVITY:

RELATIONSHIP AMONG SCIENCE, EDUCATION AND EDUCATIONAL RESEARCH:

Science helps to find out the truth behind the phenomenon. It is an approach to gathering of knowledge rather than mere subject matter. It has following two main functions:

- To develop a theory.
- To deduce hypothesis from that theory.

Scientist uses an empirical approach for data collection and rational approach for development of the theory.

Research shows a way to solve life – problems scientifically. It is a reliable tool for progress of knowledge. Being systematic and methodological, it is treated as a science. It also helps to derive the truth behind the knowledge. It offers methods of improving quality of the process and the product as well. Ultimately, Science and research go hand in hand to find out solution of the problem.

Since Philosophy offers a sound basis to education, Education is considered as an art. However, scientific progress makes education inclining towards a science rather than an art.

Science belongs to precision and exactness. It suffers hardly from any variable. But education as a social science suffers from many variables, so goes away from exactness. Educational Research tries to make educative process more scientific. But education is softening from multivariable, so it can‘t be as exact as physical sciences. If the study is systematically designed to achieve educational goals, it will be an educational research. Let us summaries this discussion with Good‘s thought –

—If we wish wisdom, we must expect science. If we wish in increase in wisdom, we must expect research‖

Knowledge is educator‘s need. Curiosity and thirst for search makes him to follow scientific way wisely. Indirectly, he plays a role of educational researcher. Ultimately he is able to solve the educational problem and generate new knowledge. All the three aspects (Science, education and educational research) have truth as a common basis, More or less, they need exactness and precision while solving a problem.

AIMS AND CHARACTERISTICS:

An enquiry is a natural technique for a search. But when it‘s used systematically and scientifically, it takes the form of a method. Scientific inquiry is also known as the scientific method. Bacon‘s inductive method contributes to human knowledge. It is difficult to solve many problems either by inductive or by deductive method. So Charles Darwin seeks happy blending of inductive and deductive method in his scientific method. In this method, initially knowledge gained from previous knowledge, experience, reflective thinking and observation is unorganized. Later on it proceeds inductively from part to whole and particular to general and ultimately to meaningful hypothesis. Thereafter, it proceeds deductively from whole to part, general to particular and hypothesis to logical conclusion.

This method is different from the methods of knowledge – generation like trial and error, experience, authority and intuition. It is a parallel to Dewey‘s reflective thinking; because the researcher himself is engrossed in reflective thinking while conducting research.

Scientific method follows five steps as under:

- Identification and definition of the problem: The researcher states the identified problem in such a manner that it can be solved through experimentation or observation.

- Formulation of hypothesis: It allows having an intelligent guess for the solution of the problem.

- Implication of hypothesis through deductive reasoning: Here, the researcher deduces the implications of suggested hypothesis, which may be true.

- Collection and analysis of evidence: The researcher is expected here to test the deduced implications of the hypothesis by collecting concerned evidence related to them through experimentation and observation.

- Verification of the hypothesis: Later on the researcher verifies whether the evidence support hypothesis. If it supports, the hypothesis is accepted, if it doesn‘t the hypothesis is not accepted and later on it is modified if it is necessary.

A peculiar feature of this method is not to prove the hypothesis as an absolute truth but to conclude that the evidence does or doesn‘t support the hypothesis.

Thus, scientific inquiry, or the scientific method, is a balanced blend of inductive and deductive approaches. It begins by moving from parts to a whole to form a meaningful hypothesis, then proceeds from the whole to parts to reach logical conclusions. A theory is a general explanation of a phenomenon that can be refined and modified based on factual knowledge and developed through the results of the scientific method.

Check your progress

6. What are the two main functions of science?

7. What is a key feature of the scientific method regarding hypotheses?

1.5 ETHICAL CONSIDERATIONS OF RESEARCH:

Research exerts a significant influence over educational systems. Hence a researcher needs to adhere to an ethical code of conduct. These ethical considerations are as follows:

- While a researcher may have some obligations to his / her client in case of sponsored research where the sponsoring agency has given him / her financial aid for conducting the research, he / she has obligations to the users, the larger society, the subjects (sample / respondents) and professional colleagues. He / she should not discard data that can lead to unfavorable conclusions and interpretations for the sponsoring agency.
- The researcher should maintain strict confidentiality about the information obtained from the respondents. No information about the personal details of the respondents should be revealed in any of the records, reports or to other individuals without the respondent's permission.
- The researcher should not make use of hidden cameras, microphones, tape-recorders or observers without the respondent's permission. Similarly, private correspondence should not be used without the concerned respondent's permission.
- In an experimental study, when volunteers are used as subjects, the researcher should explain the procedures completely (eg. the experiment will go on for six months) along with the risks involved and the demands that he / she would make upon the participants of the study (such as the subjects will be required to stay back for one hour after school hours etc.). If possible, the subjects should be informed about the purpose of the experiment / research. While dealing with school children (minors) or mentally challenged students, parents or guardian's consent should be obtained. This phenomenon is known as informed consent.
- The researcher should accept the fact that the subjects have the freedom to decline to participate or to withdraw from the experiment.
- In order to ensure the subject's inclusion and continuation in the experiment, the researcher should never try to make undue efforts giving favorable treatment after the experiment, more (additional marks) in a school subject, money and so on.
- In an experimental research which may have a temporary or permanent effect on the subjects, the researcher must take all precautions to protect the subjects from mental and physical harm, danger and stress.
- The researcher should make his / her data available to peers for scrutiny.
- The respondents / subjects / participants should be provided with the reasons for the experimental procedures as well as the findings of the study if they so demand.
- The researcher should give due credit to all those who have helped him / her in the research procedure, tool construction, data collection, data analysis or preparation of the research report.

- If at all the researcher has made some promise to the participants, it must be honored and fulfilled.

1.6 PARADIGMS OF EDUCATIONAL RESEARCH:

The idea of social construction of rationality can be pursued by considering Kuhn's idea of scientific paradigm. Thomas Kuhn, himself a historian of science, contributed to a fruitful development in the philosophy of science with his book —The Structure of Scientific Revolutions published in 1962. It brought into focus two streams of thinking about what could be regarded as 'scientific', the Aristotelian tradition with its teleological approach and the Galilean with its causal and mechanistic approach. It introduced the concept of paradigm into the philosophical debate.

Definition and Meaning of Paradigm of Research:

—Paradigm derives from the Greek verb for —exhibiting side by side‖. In lexica it is given with the translations —examples or table of changes in form and differences in form. Thus, Paradigms are ways of organizing information so that fundamental, abstract relationships can be clearly understood.

The idea of paradigm directs attention to science as having recognized patterns of commitments, questions, methods, and procedures that underlie and give direction to scientific work. Kuhn focuses upon the paradigmatic elements of research when he suggests that science has emotional and political as well as cognitive elements. We can distinguish the underlying assumptions of a paradigm by viewing its discourse as having different layers of abstractions. The layers exist simultaneously and are superimposed upon one another.

The concept of paradigm provides a way to consider the divergence in vision, custom, and tradition. It enables us to consider science as having different sets of assumptions, commitments, procedures and theories of social affairs.

A paradigm determines the criteria according to which one selects and defines problems for inquiry and how one approaches them theoretically and methodologically.

A paradigm could be regarded as a cultural man-made object, reflecting the dominant notions about scientific behaviour in a particular scientific community, be it national or international, and at a particular pointing time. Paradigms determine scientific approaches and procedures which stand out as exemplary to the new generation of scientists – as long as they do not oppose them.

A ―revolution in the world of scientific paradigms occurs when one or several researchers at a given time encounter anomalies or differences, for instance, make observations, which in a striking way to not fit the prevailing paradigm. Such anomalies can give rise to a crisis after which the universe under study is perceived in an entirely new light. Previous theories and facts become subject to thorough rethinking and revaluation.

History of Paradigms of Research:

Educational research faces a particular problem, since education, is not a well defined, unitary discipline but a practical art. Research into educational problems is conducted by scholars with many disciplinary affiliations. Most of them have a background in psychology or other behavioural sciences, but quite a few of them have a humanistic background in philosophy and history. Thus, there cannot be any prevailing paradigm or _normal science' in the very multifaceted field of educational research. However, when empirical research conducted by behavioural scientists, particularly in the Anglo-Saxon countries, in the 1960's and early 1970's began to be accused of dominating research with a positivist quantitatively oriented paradigm that prevented other paradigms of a humanistic or dialectical nature being employed, the accusations were directed at those with a behavioural science background.

During twentieth century two main paradigms were employed in researching educational problems. The one is modeled on the natural sciences with an emphasis on empirical quantifiable observations which lend themselves to analyses by means of mathematical tools. The task of research is to establish causal relationships, to explain. The other paradigm is derived from the humanities with an emphasis on holistic and qualitative information and interpretive approaches.

The two paradigms in educational research developed historically as follows. By the mid-nineteenth century, when August come \91798-1857) developed positivism in sociology and John Stuart Mill (1806-1873) empiricism in psychology. They came to serve as models and their prevailing paradigm was taken over by social scientists, particularly in the Anglo Saxon countries. In European Continent there was another from German idealism and Hegelianism. The ―Galilean‖ mechanistic conception became the dominant one particularly with mathematical physics as the methodological ideal.

There are three strands for the other main paradigm in educational research. According to the first strand, Wilhelm Dilthey (1833-1911) maintained that the humanities had their own logic of research and pointed out that the difference between natural sciences and humanities was that the former tried to explain, whereas the latter tried to understand the unique individual in his or her entire, concrete setting.

The second strand was represented by the phenomenological philosophy developed by Edmund Husserl in Germany. It emphasized the importance of taking a widened perspective and of trying to ―get to the roots‖ of human activity. The third strand in humanistic paradigm consists of the critical philosophy, which developed with certain amount of neo-Marxism.

The paradigm determines how a problem is formulated and methodologically handled. According to the traditional positivist conception, problems related to, for example, to classroom behaviour should be investigated primarily in terms of the individual actor, either the pupils, who might be neurotic, or the teacher who might be ill prepared for this her job. The other conception is to formulate the problem in terms of the larger setting, that of the school, or rather that of the society at large. By means of such mechanisms as testing, observation and the like, one does not try to find out why the pupil or the teacher deviates from the normal. Rather an attempt is made to study the particular individual as a goal directed human being with particular and unique motives.

Interdependence of the Paradigms:

One can distinguish between two main paradigms in educational research planning and with different basis of knowledge. On one hand there is functional- structural, objective – rational, goal-directed, manipulative, hierarchical, and technocratic approach. On the other hand, there is the interpretivist, humanistic, consensual, subjective, and collegial one.

The first approach is derived from classical positivism. The second one, more popular now, partly derived from the critical theory of the Frankfurt school, particularly from Habermas‘s theory of communicative action. The first approach is ―linear‖ and consists of a straight forward rational action toward preconceived problem. The second approach leaves room for reinterpretation and reshaping of the problem during the process of dialogue prior to action and even during action.

Keeves (1988) argues that the various research paradigms employed in education, the empirical-positivist, the hermeneutic or phenomenological, and the ethnographic-anthropological are complementary to each other. He talks about the ―unity of educational research,‖ makes a distinction between paradigms and approaches, and contends that there is, in the final analysis, only one paradigm but many approaches. For example, the teaching-learning process can be observed and /or video recorded. The observations can be quantified and the data analyzed by means of advanced statistical method. Content can be studied in the light of national traditions, and the philosophy underlying curriculum constructions. Both the teaching-learning process and its outcomes can be studied in a comparative, cross- national perspective.

Depending upon the objective of a particular research project, emphasis is laid more on the one or on the error paradigm. Thus qualitative and quantitative paradigms are more often than not complementing each other. For example, it is not possible to arrive at any valid information about a school or national system concerning the level of competence achieved in, for instance, science by visiting a number of classrooms and thereby trying to collect impressions. Sample surveys like one collected by IEA (International Association for the Evaluation of Educational Achievement) would be an important tool. But such surveys are not much useful if it comes to accounting for factors behind the differences between school systems. Here the qualitative information of different kinds is required.

Policymakers, planners, and administrators want generalizations and rules which apply to a wide variety of institutions with children of rather diverse backgrounds. The policymaker and planner are more interested in collectivity than in the individual child. They operate from the perspective of the whole system. Whereas, the classroom practitioners are not very much helped by generalizations which apply —on the whole‖ or —by and large‖ because they are concerned with the timely, the particular child here and now.

Need for contemporary approaches:

The behavioural sciences have equipped educational researchers with a store of research tools, such as observational methods and tests, which helps them to systematize observation which would otherwise would not have been considered in the more holistic and intuitive attempts to make, for instance, informal observations or to conduct personal interviews.

Those who turn to social science research in order to find the —best‖ pedagogy or the most —efficient‖ methods of teaching are in a way victims of traditional science which claimed to be able to arrive at generalizations applicable in practically every context. But, through critical philosophy researchers have become increasingly aware that education does not take place in a social vacuum. Educational researchers have also begun to realize that educational practices are not independent of the cultural and social context in which they operate. Nor they are neutral to educational policies. Thus the two main paradigms are not exclusive, but complementary to each other.

Check your progress:

9. Define the term paradigm.

10. List the two paradigms of research?

1.7 TYPES OF RESEARCH:

FUNDAMENTAL RESEARCH

It is basic approach which is for the sake of knowledge. Fundamental research is usually carried on in a laboratory or other sterile environment, sometimes with animals. This type of research, which has no immediate or planned application, may later result in further research of an applied nature. Basic researches involve the development of theory. It is not concerned with practical applicability and most closely resembles the laboratory conditions and controls usually associated with scientific research. It is concerned establishing generally principles of learning.

For example, much basic research has been conducted with animals to determine principles of reinforcement and their effect on learning. Like the experiment of skinner on cats gave the principle of conditioning and reinforcement.

According to Travers, basic research is designed to add to an organized body of scientific knowledge and does not necessarily produce results of immediate practical value. Basic research is primarily concerned with the formulation of the theory or a contribution to the existing body of knowledge. Its major aim is to obtain and use the empirical data to formulate, expand or evaluate theory. This type of research draws its pattern and spirit from the physical sciences. It represents a rigorous and structured type of analysis. It employs careful sampling procedures in order to extend the findings beyond the group or situations and thus develops theories by discovering proved generalizations or principles. The main aim of basic research is the discovery of knowledge solely for the sake of knowledge.

Another system for classification is sometimes used for the research dealing with these who types of questions. This classification is based on goal or objective of the research. The first type of research, which has its aim obtaining the empirical data that can be used to formulate, expand or evaluate theory are called basic research. This type of study is not oriented in design or purpose towards the solution of practical problem.

Its essential aim is to expand the frontiers of knowledge without regard to practical application. Of course, the findings may eventually apply to practical problems that have social value.

For example, advances in the practice of medicine are dependent upon basic research in biochemistry and microbiology. Likewise, progress in educational practices has been related to progress in the discovery of general laws through psychological, educational, sociological research.

Check your progress

11. What is fundamental research?

12. Where can the basic researches conducted?

APPLIED RESEARCH

The second type of research which aims to solve an immediate practical problem which is referred to as applied research. According to Travers, —applied research is undertaken to solve an immediate practical problem and the goal of adding to scientific knowledge is secondary.

It is research performed in relation to actual problems and under the conditions in which they are found in practice. Through applied research, educators are often able to solve their problems at the appropriate level of complexity, that is, in the classroom teaching learning situations. We may depend upon basic research for the discovery of more general laws of learning, but applied research much is conducted in the order to determine how these laws operate in the classroom. This approach is essential if scientific changes in teaching practice are to be effected. Unless educators undertake to solve their own practical problems of this type no one else will. It should be pointed out that applied research also uses the scientific method of enquiry. We find that there is not always a sharp line of demarcation between basic and applied research. Certainly applications are made from theory to help in the solution of practical problems. We attempt to apply the theories of learning in the classroom. On the other hand, basic research may depend upon the findings of the applied research to complete its theoretical formulations. A classroom learning experiment can throw some light on the learning theory. Furthermore, observations in the practical situations serve to test theories and may lead to the formulation of new theories.

Most educational research studies are classified at the applied end of the continuum; they are more concerned with —what‖ works best than with —whom. For example, in applied research the principle of reinforcement to determine their effectiveness in improving learning (e.g. programmed instruction) and behaviour (e.g. behaviour modification). Applied research has most of the characteristics of fundamental research, including the use of sampling techniques and the subsequent inferences about the target population. Its purpose, however, is improving a product or a process – testing theoretical concepts in actual problem situations. Most educational research is applied research, for it attempts to develop generalizations about teaching – learning processes and instructional materials.

The applied research may also be employed a university or research institute or may be found in private industry or working for a government agency. In the field of education

such a person might be employed by a curriculum publishing company, a state department of education, or a college of education at a university. Applied researches are also found in the settings in which the application or practitioner‘s role is primary. This is where the teachers, clinical psychologists, school psychologists, social workers physicians, civil engineers, managers, advertising specialists and so on are found. Many of these people receive training in doing research, and they use this knowledge for two purpose.

(1) To help practitioners understand, evaluate, and use the research produced by basic and applied researches in their own fields and,

(2) To develop a systematic way of addressing the practical problems and questions that arises as they practice their professions.

For example, a teacher who notices that a segment of the class is not adequately motivated in science might look at the research literature on teaching science and then systematically try some of the findings suggested by the research.

Some of the recent focus of applied educational research have been grading practices, collective bargaining for school personnel, curriculum content, instructional procedures, educational technology, and assessment of achievement. The topics have been investigated with an applied research because the questions raised in these areas generally have limited or no concrete knowledge of theory we can draw upon directly to aid in decision making.

Check your progress

13. What do you mean by applied research?

14. What is the primary aim of applied research?

15. What are some recent focuses of applied educational research?

ACTION RESEARCH

Research designed to uncover effective ways of dealing with problems in the real world can be referred to as action research. This kind of research is not confined to a particular methodology or paradigm. For example, a study might examine the effectiveness of training teenage parents to care for their infants. The study is based on statistical and other evidence that infants of teenage mothers seemed to be exposed to more risks than other infants. The mother and children were recruited for participation in the study while the children were still in neonate period. Mothers were trained at home or in an infant nursery. A controlled group received no training. The mothers trained at home were visited at 2-weeks interval over a 12-month period. Those trained in nursery setting attended 3-days

per week for 6 months, were paid minimum wage, and assisted as staff in center. Results of the study suggested that the children of both group of trained mothers benefited more in terms of their health and cognitive measures than did the controlled children. Generally greater benefits were realized by the children of the mothers trained in the nursery that with the mothers trained at home.

Thus the study shows that such researches have direct application to real world problems. Second, elements of both quantitative and qualitative approaches can be found in the study. For example, quantitative measure of weight, height, and cognitive skills were obtained in this study. However, at the start itself from the personal impressions and observations without the benefit of systematic quantitative data, the researches was able to say that the mother in the nursery centre showed some unexpected vocational aspirations to become nurses. Third, treatments and methods that are investigated are flexible and might change during the study in response to the results as they are obtained. Thus, action research is more systematic and empirical than some other approaches to innovation and change, but it does not lead to careful controlled scientific experiments that are generalizable to a wide variety of situations and settings.

The purpose of action research is to solve classroom problems through the application of scientific methods. It is concerned with a local problem and is conducted in a local setting. It is not concerned with whether the results are generalizable to any other setting and is not characterized by the same kind of control evidence in other categories of research. The primary goal of action research is the solution of a given problem, not contribution to science. Whether the research is conducted in one classroom or many classrooms, the teacher is very much a part of the process. The more research trainings the teacher involved have had, the more likely it is that the research will produce valid, if not generalizable research.

The value of action research is confined primarily to those who are conducting it. Despite its shortcomings, it does represents a scientific approach to the problem solving that is considerably better than changed based on the alleged effectiveness of untried procedures, and infinitely better than no changes at all. It is a means by which concerned school personnel can attempt to improve the educational process, at least within their environment. Of course, the true value of action research to true scientific progress is limited. True progress requires the development of sound theories having implications for many classrooms, not just one or two. One sound theory that includes ten principles of learning may eliminate the need of hundreds of would – be action research studies. Given the current status of educational theory, however, action research provides immediate answers to problem that cannot wait for theoretical solutions.

As John Best puts it, action research is focused on immediate applications. Its purposes is to improve school practices and at the same time, to improve those who try to improve the practices, to combine the research processes, habits of thinking, ability to work harmoniously with others, and professional spirit.

If most classroom teachers are to be involved in research activity, it will probably be in the area of action research. Many observers have projected action research nothing more than the application of common sense or good management. Whether or not it is worthy of the term research it does not apply scientific thinking and methods to real life problems and represents a greater improvement over teachers‘ subjective judgments and decision based upon stereotype thinking and limited personal experience.

The concept of action research under the leadership of Corey has been instrumental in bringing educational research nearer to educational practitioners. Action research is research undertaken by practitioners in order that they may attempt to solve their local, practical problems by using the method of science.

Check your progress

16. What do you mean by action research?

17. How does action research differ from other types of research?

1.8 LET US SUM UP

In this chapter, we delved into the foundational aspects of educational research, starting with an overview of its significance in shaping effective teaching and learning. We explored various sources for acquiring knowledge, emphasizing the need for diverse and reliable information. The chapter then outlined the essential steps and scope of educational research, highlighting the importance of a systematic approach. We discussed the scientific method, its aims, and its key characteristics, illustrating how it supports rigorous and objective inquiry. Ethical considerations were also addressed, stressing the importance of conducting research with integrity and respect. We examined different research paradigms to provide a broader understanding of methodological approaches, and reviewed various types of research, each contributing uniquely to advancing educational knowledge and practices. Overall, this chapter equips readers with a solid foundation in educational research, setting the stage for meaningful and ethical exploration in the field.

1.9 FURTHER READING

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1.10 ANSWER TO CHECK YOUR PROGRESS

1. To solve education problem.

2. Scientific method.

3. Interdisciplinary approach.

4. Classroom, school, college, department of education.

5. Educational research involves individuals like students, teachers, educational managers, and parents, as well as institutions such as schools and colleges.

6. (a)To develop a theory (b) to deduce hypothesis from that theory.

7. Do not have to prove the hypothesis as an absolute truth but to conclude that the evidence does or doesn‘t support the hypothesis.

8. Paradigm derives from the Greek verb for ―exhibiting side by side. In lexica it is given with the translations ―examples or table of changes in form and differences in form. Thus, Paradigms are ways of organizing information so that fundamental, abstract relationships can be clearly understood.

9. Fundamental research, often conducted in controlled environments like laboratories and sometimes involving animals, aims to expand knowledge without immediate practical applications. This type of research may later lead to applied research with practical uses.

10. Basic research is typically conducted in controlled environments such as: Laboratories, Research institutions, field sites etc.

11. Applied research is undertaken to solve an immediate practical problem and the goal of adding to scientific knowledge is secondary. It is research performed in relation to actual problems and under the conditions in which they are found in practice.

12. To solve immediate practical problems, with adding to scientific knowledge as a secondary goal.

13. Grading practices, curriculum content, instructional procedures, educational technology, and assessment of achievement.

14. Action Research is a collaborative and iterative approach aimed at solving practical problems through direct intervention and ongoing feedback. Researchers work closely with participants to identify issues, implement solutions, and assess outcomes in real-time.

Action research aims at immediate problem-solving through iterative, participatory processes, whereas basic research focuses on expanding theoretical knowledge, and applied research addresses specific issues with less iterative involvement.

1.11 Model Questions

1. Discuss the significance of research in enhancing the quality of human life and describe how it contributes to educational improvement.

2. Explain the different sources of acquiring knowledge as mentioned in the chapter and provide examples for each source.

3. Describe the process and steps involved in conducting educational research, highlighting the importance of each step.

4. What are the main characteristics of educational research? How does it differ from other forms of research?

5. Compare and contrast the primary aims of basic research, applied research, and action research. How do their methodologies and outcomes differ?

6. Explain the concept of scientific method in research. How does it integrate inductive and deductive reasoning?

7. What are the key ethical considerations researchers must adhere to while conducting educational research? Provide examples for each consideration.

8. Discuss Thomas Kuhn's concept of paradigm in scientific research. How does it relate to educational research, and what are the implications for understanding educational phenomena?

9. Describe the two main paradigms of educational research. How do they differ in their approach and application?

10. What role do science, education, and educational research play in understanding and solving educational problems? Discuss their interconnections and contributions to knowledge advancement.

11. Explain the characteristics and goals of fundamental research in educational psychology. How does it differ from applied research in terms of methodology and objectives?

12. Discuss the importance of fundamental research in the development of educational theories. Provide examples of how basic research in areas such as reinforcement and conditioning has contributed to our understanding of learning processes.

13. Describe the main objectives of applied research. How does it use findings from fundamental research to address practical problems in educational settings? Provide examples of how applied research has influenced classroom practices.

14. Compare and contrast action research with fundamental and applied research. How does action research address immediate problems in educational settings, and what are its primary goals? Discuss its benefits and limitations.

15. How does action research contribute to the improvement of classroom practices? Evaluate the role of teachers in action research and discuss how their involvement can affect the outcomes of the research.

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Unit 2
RESEARCH DESIGN

Unit Structure

2.0 LEARNING OBJECTIVES

- ✓ To define the concept of research design.
- ✓ To explain the purpose of research design.
- ✓ To differentiate between research methods and research methodology.
- ✓ To discuss the purposes of a research proposal.
- ✓ To identify the various components of a research proposal.
- ✓ To develop a written research proposal for a specified topic.

2.1 MEANING, DEFINITION, PURPOSE AND COMPONENTS OF RESEARCH DESIGN

Meaning of Research Design: Before embarking on research, an investigator typically starts by identifying a problem and immersing themselves in relevant literature, including books, journals, and research reports. This exploration helps them pinpoint a specific research topic. Throughout this process, close collaboration with a mentor or guide is crucial. Once the topic is set, the next step is to determine the research design.

Research design is a blue print or structure with in which research is conducted. It constitutes the blue print for the collection, measurement and analysis of data. According to Gay and Airasian (2000), ―A design is general strategy for conducting a research study. The nature of the hypothesis, the variables involved, and the constraints of the ―real world‖ all contribute to the selection of design.‖ Kothari (1988) says, ―Decisions regarding WHAT?, WHERE?, WHEN?, HOW MUCH?, by WHAT? means concerning an inquiry or a research study constitute research design.

Thus, it can be said that research design is an outline of what the researcher will do from writing of objectives, hypotheses and its operational implications to find analysis of data. Research design should be able to convey following:

- ➢ What is the study about?
- ➢ Where will study be carried out?
- ➢ What type of data is necessary?
- ➢ Where necessary data is available?
- ➢ How much time is needed to complete the study?
- ➢ What will be the sampling design?
- ➢ Which tools will be identified to collect data?
- ➢ How data will be analysed?

Depending upon the types of research the structure of design may vary. Suppose, one is conducting an experimental research, then identification of variables, control of variables, types of experimental design etc. be discussed properly. If someone is conducting qualitative research, then one should stress on understanding of setting, nature of data, holistic approach, selection of participants, inductive data analysis. Thus, according to nature and type of study the components of design will be decided.

In short, any efficient research design will help the researcher to carry out the study in a systematic way.

PURPOSE

A research design is like a roadmap for an investigator, helping them address the research problem and navigate through the entire research process. It outlines how to collect data, what observations to make, and how to analyze the data effectively.

Additionally, the design provides guidance on the statistical techniques to use for data analysis and helps control variables, especially in experimental research.

In essence, a well-crafted research design ensures that the investigator can carry out the research efficiently and systematically. The design is considered complete or adequate when the investigator can follow its steps to successfully conduct their research.

COMPONENTS OF RESEARCH DESIGN

- Research Problem: This is the clear statement or question that the research is trying to answer.
- Objectives: These are the specific goals or outcomes that the research aims to achieve.
- Hypothesis: This is a tentative idea or prediction that the research will test to see if it holds true.
- Research Methodology: This outlines the overall strategy for the research, including how data will be collected and analyzed.
- Sampling: This is about choosing a smaller group from a larger population to study, including how this group will be selected and how many people or items will be involved.
- Data Collection: This involves the methods and tools used to gather information, such as surveys, interviews, or observations.

- Data Analysis: This is the process of making sense of the collected data using various techniques, including statistical methods.

- Variables: These are the different factors or elements in the study, including what's being measured or changed. They include independent variables (what you change), dependent variables (what you measure), and control variables (what you keep constant).

- Ethical Considerations: This covers the guidelines to ensure the research is conducted ethically, including getting consent from participants and keeping their information confidential.

- Timeline: This is a plan that shows the major stages of the research and when they will be completed.

- Budget: This details the financial resources needed for the research, including costs for materials, staff, and other expenses.

- Limitations: These are the potential challenges or constraints that could affect the results or how they are interpreted.

- Reporting and Dissemination: This is the plan for sharing the research findings, including how the results will be presented in reports, publications, or presentations.

Check your progress

1. What is research design?

2. Why is a research design important?

2.2 DIFFERENCE BETWEEN THE TERMS RESEARCH METHOD AND RESEARCH METHODOLOGY:

While preparing the design of the study, it is necessary to think of research method. It is simply the method for conducting research. Generally, such methods are divided into quantitative and qualitative methods. Such quantitative methods include descriptive research, evaluation research and assessment research. Assessment type of studies include surveys, public opinion polls, assessment of educational achievement. Evaluation studies include school surveys, follow up studies. Descriptive research studies are concerned with analysis of the relationships between non manipulated variables. Apart from these

quantitative methods, educational research also includes experimental and quasi experimented research, survey research and causal-comparative research.

Qualitative research methods include ethnography, phenomenology, ethnomethodology, narrative research, grounded theory, symbolic interaction and case study.

Thus, the researcher should mention about methods of research used in his research with proper justification for its use.

The term methodology seems to be broader, in the sense it includes nature of population, selection of sample, selection / preparation of tools, collection of data and how data will be analysed. Here the method of research is also included.

2.3 RESEARCH PROPOSAL: ITS MEANING AND NEED

Preparing the research proposal is an important step because at this stage, entire research project gets a concrete shape. Researcher‘s insight and inspiration are translated into a step by step plan for discovering new knowledge. Proposal is more than research design. Research design is a subset of proposal. Ordinarily research design will not talk much about heretical frame work of the study. It will be also silent about the review of related studies. A strong rationale for conducting research is also not part of research design. At the stage of writing proposal, the entire research work shapes into concrete form. In the proposal, the researcher demonstrates that he is familiar with what he is doing.

a. Identification of Research Topic: Sources and Need

- Finding Your Topic: This is where you zero in on what you want to study.
- Start by:
- Exploring Existing Research: Dive into academic journals, books, and reports to see what’s already been done. Look for interesting gaps or unresolved issues.
- Following Your Interests: Pick something that genuinely excites you and aligns with your expertise or curiosity.
- Considering Practical Impact: Think about whether your research could address a real-world problem or benefit a particular group.
- Sources to Consider:

- Academic Journals: Articles in peer-reviewed journals give you a snapshot of the latest research and discussions.
- Books: Scholarly books offer a deeper dive into theories and frameworks.
- Theses and Dissertations: Look at past research to understand current trends and methodologies.
- Reports: Check out professional and governmental reports for real-world data and insights.
- Why It Matters: Identify why your topic is important. Is it a pressing issue? Does it fill a gap in existing knowledge? How will it benefit others?

b. Review of Related Literature

Looking at What's Out There: This step involves reading up on what others have said about your topic. It helps you:

Understand the Field: Get a solid grasp of the theories and findings that have shaped current knowledge.

Spot Gaps: Identify areas that haven't been explored thoroughly or where there are conflicting results.

Build on Existing Knowledge: Use what's already known to support and shape your own research.

Position your Study: Show how your work fits into the larger academic conversation and why it's needed.

c. Rationale and Need for the Study

Why Your Study Is Important:

Purpose: Explain what you hope to achieve with your research and why it matters.

Impact: Describe the potential benefits of your findings and who will benefit from them.

Need for the Study: Highlight why your research is necessary:

Filling gaps: Show how your work will address unanswered questions or unresolved issues.

Practical Benefits: Consider how your findings might be used in real-life settings.

Theoretical Contributions: Discuss how your study will contribute to existing theories or frameworks.

d. Definition of Terms

Clarifying Key Terms: Define the important terms and concepts you'll use in your research to avoid confusion:

Be Clear: Make sure your definitions are straightforward and easy to understand.

Contextualize: Explain how these terms are used specifically in your study.

Stay Consistent: Use the same definitions throughout your research to maintain clarity.

e. Variables

Understanding Your Variables: Identify the elements of your research:

Independent Variables: What you change or manipulate to see its effect.

Dependent Variables: What you measure to see if there's an impact.

Control Variables: Factors you keep constant to ensure they don't affect the outcome.

Confounding Variables: Potentially disruptive factors that might influence the results.

f. Research Questions, Objectives, and Hypotheses

Formulating Your Questions and Goals

Research Questions: What are you trying to find out? Ask clear, specific questions that guide your study.

Objectives: Define what you aim to accomplish. These should be clear, achievable, and measurable.

Hypotheses: Make educated guesses about what you expect to discover. These should be testable and related to your research questions.

g. Assumptions (if any)

Stating Your Assumptions: Outline the underlying beliefs or conditions that your research is based on:

Contextual Assumptions: Beliefs about the setting or environment of your study.

Methodological Assumptions: Assumptions about your research methods and their reliability.

Theoretical Assumptions: Foundations based on existing theories or models.

h. Scope, Limitations, and Delimitations

Defining the Boundaries of Your Research:

Scope: What aspects of the topic will you cover? This includes the geographic area, time period, and specific aspects of the subject.

Limitations: Acknowledge any weaknesses or constraints in your study, such as methodological issues or sample size limitations.

Delimitations: Explain the boundaries you set for your study, such as what you chose to include or exclude and why.

i. Method, Sample, and Tools

Describing how you'll Conduct Your Research:

Method: Explain your research design and approach—will you use surveys, experiments, interviews, or a mix?

Sample: Describe who or what will be included in your study, how you'll select them, and why this sample is appropriate.

Tools: Identify the instruments or techniques you'll use to collect and analyze data, such as questionnaires, interview guides, or observation checklists.

j. Significance of Study

Why your Research Matter:

Contribution to Knowledge: Explain how your study adds to existing knowledge or understanding in your field.

Practical Implications: Discuss how your findings might be applied in practice or policy.

Societal Relevance: Consider the broader impact of your research on society or specific communities.

k. Technique for Data Analysis

How you'll analyze Your Data:

Quantitative Analysis: Outline the statistical methods you'll use, such as descriptive statistics or regression analysis.

Qualitative Analysis: Describe how you'll interpret qualitative data, such as through thematic analysis or content analysis.

Mixed Methods Analysis: If applicable, explain how you'll integrate both quantitative and qualitative data for a comprehensive view.

3. Why is a research proposal important?

4. What should be included in the identification of a research topic?

5. What are independent and dependent variables?

6. What is the purpose of reviewing related literature?

2.4 Let us sum up

In this chapter, we've taken a deep dive into what makes a research design effective. We started by breaking down what research design is and how it differs from methods and methodology. You learned about the key pieces of a research proposal, from picking a topic and reviewing existing literature to defining terms and setting up variables. We also covered why your study matters, how to handle assumptions and limitations, and how to choose the right methods and tools for collecting and analyzing data. By putting these pieces together, you're now better prepared to create a clear and impactful research proposal.

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2.6 Answer to check your progress

1. Research design is a blueprint or structure for conducting research, outlining how data will be collected, measured, and analyzed.

2. A research design provides a roadmap for systematically addressing the research problem, guiding data collection, observation, and analysis, and ensuring efficient and effective research execution.

3. A research proposal is crucial because it translates a researcher's ideas into a structured plan, outlining the entire research project, including the rationale, design, and methodology.

4. The identification of a research topic should involve exploring existing research, following personal interests, and considering the practical impact of the study.

5. Independent variables are factors that are manipulated to observe their effects, while dependent variables are the outcomes measured to see if there is an impact.

6. Reviewing related literature helps understand the field, identify gaps, build on existing knowledge, and position your study within the larger academic conversation.

2.7 Model Questions

1) Explain the meaning and purpose of research design. How does it guide the research process? Discuss its main components with examples.

2) Differentiate between research method and research methodology. Provide examples of quantitative and qualitative methods and discuss their applications.

3) What is a research proposal, and why is it essential in the research process? Describe its relationship with research design and outline the key elements it should contain.

4) Discuss the process of identifying a research topic. What sources can researchers use, and why is the selection of a relevant topic important for a successful study?

5) How does the review of related literature contribute to the research process? Explain how it helps in understanding the field and identifying gaps in existing research.

6) Define research variables and explain their significance in a study. Discuss the types of variables, providing examples for each.

7) What are research questions, objectives, and hypotheses? How do they interrelate, and why are they crucial for guiding a research study?

8) Outline the importance of scope, limitations, and delimitations in a research study. How do these factors affect the interpretation of research findings?

9) Describe the steps involved in selecting a research method, sample, and tools. How do these choices impact the validity and reliability of a study?

10) Discuss the significance of a research study. How can a study contribute to existing knowledge, and what are its potential practical and societal implications?

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Unit 3
VARIABLES AND HYPOTHESES

Unit Structure

3.0 LEARNING OBJECTIVES

- ✓ To understand and differentiate various types of variables.
- ✓ To explore and identify different types of hypotheses.
- ✓ To formulate clear and testable hypotheses.
- ✓ To evaluate the characteristics of a good hypothesis.
- ✓ To identify and analyze errors in hypothesis testing.

3.1 INTRODUCTION:

In research, each person or item from which we collect data is called an observation, typically referring to people or subjects. These observations possess different characteristics. When a characteristic is uniform across all members of a group, it is known as a constant. On the other hand, when a characteristic varies among members, it is termed a variable. Researchers are particularly interested in variables because they reveal differences and patterns that can lead to meaningful insights, unlike constants, which do not provide this diversity since they remain the same across the board. This focus on variables helps in understanding and analyzing the dynamics within a group.

3.2 MEANING OF VARIABLES

A variable is any entity that can take on different values. So what does that mean? Anything that can vary can be considered a variable. For instance, age can be considered a variable because age can take different values for different people or for the same person at different times. Similarly, country can be considered a variable because a person's country can be assigned a value.

A variable is a concept or abstract idea that can be described in measurable terms. In research, this term refers to the measurable characteristics, qualities, traits, or attributes of a particular individual, object, or situation being studied.

Variables are properties or characteristics of some event, object, or person that can take on different values or amounts.

Variables are things that we measure, control, or manipulate in research. They differ in many respects, most notably in the role they are given in our research and in the type of measures that can be applied to them.

By itself, the statement of the problem usually provides only general direction for the research study; it does not include all the specific information. There is some basic terminology that is extremely important in how we communicate specific information about research problems and about research in general.

Let us analyse an example; if a researcher is interested in the effects of two different teaching methods on the science achievement of fifth-grade students, the grade level is constant, because all individuals involved are fifth-graders. This characteristic is the same for everyone; it is a ‘constant’ condition of the study.

After the different teaching methods have been implemented, the fifth-graders involved would be measured with a science achievement test. It is very unlikely that all of the fifth-graders would receive the same score on this test, hence the score on the science

achievement test becomes a variable, because different individuals will have different scores; at least, not all individuals will have the same scores. We would say that science achievement is a variable, but we would mean, specifically, that the score on the science achievement test is a variable.

There is another variable in the preceding example – the teaching method. In contrast to the science achievement test score, which undoubtedly would be measured on a scale with many possible values, teaching method is a categorical variable consisting of only two categories, the two methods. Thus, we have different kinds of variables and different names or classifications for them.

A concept which can take on different quantitative values is called a variable. As such the concepts like weight, height, income are all examples of variables. Qualitative phenomena (or the attributes) are also quantified on the basis of the presence or absence of the concerning attributes(s). Age is an example of continuous variable, but the number of male and female respondents is an example of discrete variable.

3.3 TYPES OF VARIABLES:

There are many classification systems given in the literature the names we use are descriptive; they describe the roles that variables play in a research study. The variables described below by no means exhaust the different systems and names that exist, but they are the most useful for communicating about educational research.

- **Independent variables:**

Independent variables are variables which are manipulated or controlled or changed. In the example "a study of the effect of teacher praise on the reading achievement of second-graders", the effect of praise, the researcher is trying to determine whether there is a cause-and-effect relationship, so the kind of praise is varied to see whether it produces different scores on the reading achievement test. We call this a manipulated independent variable (treatment variable). The amount and kind of praise is manipulated by the researcher. The researcher could analyze the scores for boys and girls separately to see whether the results are the same for both genders. In this case gender is a classifying or attributes independent variable. The researcher cannot manipulate gender, but can classify the children according to gender.

- **Dependent variables:**

Dependent variables are the outcome variables and are the variables for which we calculate statistics. The variable which changes on account of independent variable is known as dependent variable.

Let us take the example, a study of the effect of teacher praise on the reading achievement of second-graders; the dependent variable is reading achievement. We might compare the average reading achievement scores of second-graders in different praise conditions such as no praise, oral praise, written praise, and combined oral and written praise.

The following example further illustrates the use of variables and constants. In a study conducted to determine the effect of three different teaching methods on achievement in elementary algebra, each of three ninth-grade algebra sections in the same school, taught by the same teacher, is taught using one of the methods. Both boys and girls are included in the study. The constants in the study are grade level, school, and teacher. (This assumes that, except for method, the teacher can hold teaching effectiveness constant.) The independent variables in the study are teaching method and gender of the student. Teaching method has three levels that arbitrarily can be designated methods A, B, and C; gender of the student, of course, has two levels. Achievement in algebra, as measured at the end of the instructional period, is the dependent variable.

The terms dependent and independent variable apply mostly to experimental research where some variables are manipulated, and in this sense they are "independent" from the initial reaction patterns, features, intentions, etc. of the subjects. Some other variables are expected to be "dependent" on the manipulation or experimental conditions. That is to say, they depend on "what the subject will do" in response. Somewhat contrary to the nature of this distinction, these terms are also used in studies where we do not literally manipulate independent variables, but only assign subjects to "experimental groups" based on some pre-existing properties of the subjects. . Independent variables are those that are manipulated whereas dependent variables are only measured or registered.

Example 1: A study of teacher-student classroom interactions at different levels of schooling.

Independent Variable: Level of schooling, with four categories: primary, upper primary, secondary, and junior college.

Dependent Variable: Score on a classroom observation inventory, which measures teacher-student interaction.

Example 2: A comparative study of the professional attitudes of secondary school teachers by gender.

Independent Variable: Gender of the teacher—male or female.

Dependent Variable: Score on a professional attitude inventory.

- **Extraneous variable:**

In research, there are key factors we focus on, and others that might influence the results even if they aren't the main interest—these are called extraneous variables. Imagine you're studying how kids' self-esteem impacts their performance in social studies. Here, self-esteem is the primary factor (independent variable), and their performance is the outcome we're interested in (dependent variable). While intelligence might also affect performance, it's not the focus of this study, so it's considered an extraneous variable. Any influence from these factors is known as an "experimental error."

It's crucial to design studies so that any changes observed in the dependent variable are due to the main factor, not influenced by extraneous ones. For instance, when examining teaching methods in Social Science, elements like a teacher's skill, enthusiasm, age, and students' socioeconomic backgrounds can significantly affect the learning process. These variables are challenging to control, making it difficult to attribute outcomes solely to the teaching methods being studied. As a result, conclusions can become less reliable due to the unintended impact of these extraneous factors. Addressing these issues helps ensure that research findings are credible and accurately reflect the effects of the independent variable.

- **Intervening variables:**

Intervening variables can complicate the relationship between cause and effect, often making them difficult to observe. These variables are connected to individual feelings and states, such as boredom, fatigue, or excitement. Even though they can be challenging to measure or control, they play a crucial role in influencing the outcomes of a study by intervening in the cause-and-effect process.

For instance, consider a study investigating the "Effect of Immediate Reinforcement on Learning the Parts of Speech." Here, factors like anxiety, fatigue, and motivation could act as intervening variables. While these factors are hard to define in precise, observable terms, their impact on the results is significant. For example, a student feeling anxious or fatigued might not respond to immediate reinforcement in the same way as a student who is engaged and motivated.

Although controlling for these variables can be tricky, it's important to address them in the study's design. By acknowledging and accounting for these intervening factors, researchers

can better isolate the true effects of the independent variable and ensure more reliable and meaningful results.

- **Moderator:**

A moderator variable is a type of independent variable that, while not the primary focus of a study, can influence the relationship between an independent and a dependent variable. It has its own levels that, when combined with the levels of the main independent variable, produce varying effects on the dependent variable.

For example, imagine a study designed to assess how different lengths of reading passages affect comprehension. The study includes passages of three lengths: 100 words, 200 words, and 300 words. Participants are fourth, fifth, and sixth graders.

If the study finds that all the grade levels perform similarly well on the 100-word passages, but only the sixth graders excel on the 300-word passages, this indicates that the effectiveness of passage length on comprehension is moderated by grade level. In this case, grade level is the moderator variable because it changes how passage length impacts comprehension across different age groups.

So, while the passage length is directly related to comprehension, the effect of passage length varies depending on the students' grade levels. Understanding this moderation helps researchers grasp how different factors interact and influence each other, providing a more nuanced view of the study's results.

Check your progress

1. What is a variable in research?
2. Give an example of an extraneous variable.
3. What is the role of a moderator variable in research?
4. How does a constant differ from a variable in a research study?
5. What distinguishes an independent variable from a dependent variable?

3.4 CONCEPT & SOURCES OF HYPOTHESIS

Hypothesis is usually considered as the principal instrument in research. The derivation of a suitable hypothesis goes hand in hand with the selection of a research problem. A hypothesis, as a tentative hunch, explains the situation under observation so as to design the study to prove or disprove it. What a researcher is looking for is a working or positive hypothesis. It is very difficult, laborious and time consuming to make adequate discriminations in the complex interplay of facts without hypothesis. It gives definite point and direction to the study, prevents blind search and indiscriminate gathering of data and helps to delimit the field of inquiry.

- **Meaning:**

The term "hypothesis" (plural: hypotheses) originates from the Greek word hypotithenai, which means "to put under" or "to suppose." In scientific research, a hypothesis is a proposed explanation or prediction that must be testable through the scientific method.

Etymologically, "hypothesis" is derived from two Greek words: hypo (meaning "less than") and thesis (meaning "a proposition" or "statement"). Thus, a hypothesis is considered a proposition that is less certain than a fully established thesis. It represents a tentative statement or educated guess based on available evidence, which the researcher aims to validate through study.

Lundberg defines a hypothesis as "a tentative generalization that remains to be tested." At its most basic level, a hypothesis may start as a hunch, guess, or imaginative idea that forms the basis for further investigation.

Goode and Hatt describe a hypothesis as "a proposition that can be tested to determine its validity." It is a provisional statement accepted as true based on current knowledge about a phenomenon and serves as a foundation for exploring new truths.

A hypothesis is essentially a provisional assumption derived from existing knowledge and theory. It acts as a guide in the investigation of unknown facts and theories, offering a plausible explanation for known phenomena and directing the search for new information.

In practical terms, a hypothesis is a well-informed guess or tentative inference about the existence of some fact, condition, or relationship related to a specific phenomenon. It aims to explain what is already known and to guide the discovery of new truths based on empirical evidence. Researchers test hypotheses to evaluate their validity and reliability.

For instance, Lundberg notes that research hypotheses are often predictive statements that can be tested scientifically, relating an independent variable to a dependent variable. Examples include statements like, "Students who receive counseling will show a greater increase in creativity than those who do not," or "There is a positive relationship between academic aptitude scores and scores on a social adjustment inventory for high school

students." These hypotheses are structured to be objectively verified and tested, demonstrating that a hypothesis outlines what researchers are investigating and provides a testable proposition to determine its validity.

- **Importance of the Hypotheses:**

The importance of hypotheses is particularly evident in studies aimed at predicting outcomes. In experimental research, hypotheses play a crucial role because they guide predictions about the results of an experiment and what the expected outcomes might be. In contrast, historical or descriptive research, which focuses on documenting events, studying the history of a city or nation, or analyzing the life of an individual, may not always require hypotheses. Such studies often seek to uncover facts or establish the current state of a situation without making predictions. Hillway (1964) suggests that "when fact-finding alone is the aim of the study, a hypothesis may not be required."

However, even in historical or descriptive research, the ability to interpret facts and draw generalizations is essential. For example, tracing the history of an educational institution or analyzing electoral results requires not only gathering facts but also making sense of them to draw meaningful conclusions. In such cases, a hypothesis can provide valuable insights and guide the research process.

The significance of hypotheses in research can be summarized as follows:

- Facilitating Knowledge Extension: Hypotheses offer tentative explanations for facts and phenomena, which can be tested and validated. They help researchers focus on relevant aspects of the problem, thereby extending knowledge in the field.
- Providing Rational Statements: Hypotheses present logical relationships between known facts and educated guesses about unknown conditions. They guide the thinking process and discovery, acting as a "guiding light" in the research process.
- Directing Research Efforts: Hypotheses define what is relevant and what is not, guiding researchers in their investigation. They help avoid unnecessary literature reviews and data collection, influence sample selection, research procedures, and statistical techniques, and keep the study focused and manageable.
- Framework for Reporting Conclusions: Hypotheses provide a structured approach for reporting study findings. Researchers can test each hypothesis individually and present conclusions clearly, making the research report more organized and meaningful.

Check your progress

6. What is the origin of the word "hypothesis"?

7. What role do hypotheses play in experimental research?

8. How do hypotheses contribute to the research process?

- **SOURCES OF HYPOTHESIS:**

The derivation of a good hypothesis demands characteristic of experience and creativity. Though hypothesis should precede the gathering of data, a good hypothesis can come only from experience. Some degree of data gathering, the review of related literature, or a pilot study must precede the development and gradual refinement of the hypothesis. A good investigator must have not only an alert mind capable of deriving relevant hypothesis, but also a critical mind capable of rejecting faulty hypothesis.

Hypotheses can be derived from various sources depending on the research context. They may originate from the statement of the problem, be based on existing research literature, or emerge from data collection and analysis, especially in qualitative studies like ethnography. Here are several key sources of hypotheses:

- Review of Similar Studies: Analyzing existing research on similar topics or related problems can provide insights and lead to the formulation of new hypotheses. By examining how others have approached comparable issues, researchers can identify gaps, patterns, and trends that inform their own hypotheses.

- Examination of Data and Records: Reviewing available data and records related to the problem can reveal trends, anomalies, or clues that suggest new hypotheses. This involves analyzing historical data, statistics, or other relevant documents to uncover insights that may not be immediately apparent.

- Discussions with Colleagues and Experts: Engaging in discussions with peers, colleagues, and subject matter experts can generate hypotheses. These conversations can provide new perspectives, highlight overlooked aspects of the problem, and refine the research objectives.

- Exploratory Personal Investigation: Conducting preliminary fieldwork, such as interviews or surveys with individuals directly involved in or affected by the problem, can help develop hypotheses. This hands-on approach offers practical insights and a deeper understanding of the issue at hand.

- Intuition: Often, seasoned researchers or theorists use their intuition, grounded in extensive experience and knowledge, to formulate hypotheses. This intuition is based on a deep understanding of the subject matter and existing research.

- Rational Induction: Combining empirical findings from various research areas through logical reasoning can lead to the development of new hypotheses. This approach involves synthesizing data from different studies to generate new insights and predictions.

- Prior Empirical Research: Prior empirical findings are a common source for generating new hypotheses. By building on previous research and using rational induction to integrate and expand on existing knowledge, researchers can develop hypotheses that advance understanding in their field.

Check your progress

9. What is a common source for generating new hypotheses in research?

10. What role does intuition play in formulating hypotheses?

3.6 TYPES OF HYPOTHESIS:

- **Research hypothesis:** When a prediction or a hypothesized relationship is to be tested by scientific methods, it is termed as research hypothesis. The research hypothesis is a predictive statement that relates an independent variable to a dependent variable. Usually a research hypothesis must contain, at least, one independent and one dependent variable. A research hypothesis must be stated in a testable form for its proper evaluation. As already stressed, this form should indicate a relationship between the variables in clear, concise, and understandable language. Research hypotheses are classified as being directional or non-directional.

- **Directional hypothesis:** The hypotheses which stipulate the direction of the expected differences or relationships are terms as directional hypotheses. For example, the research hypothesis: "There will be a positive relationship between individual's attitude towards high caste Hindus and his socio- economic status," is a directional research hypothesis. This hypothesis stipulates that individuals with favourable attitude towards high cast Hindus will generally come from higher socio-economic Hindu families and therefore it does stipulate the direction of the relationship. Similarly, the hypothesis: "Adolescent boys with high IQ will exhibit low anxiety than adolescent boys with low IQ" is a directional research hypothesis because it stipulates the direction of the difference between groups.

- **Non-directional hypothesis:** A research hypothesis which does not specify the direction of expected differences or relationships is a non-directional research hypothesis. For example, the hypotheses: "There will be difference in the adaptability of fathers and mothers towards rearing of their children" or "There is a difference in the anxiety level of adolescent girls of high IQ and low IQ" are non-directional research hypotheses. Although these hypotheses stipulate there will be a difference, the direction of the difference is not specified. A research hypothesis can take either statistical form, declarative form, the null form, or the question form.

- **Statistical hypothesis:** When it is time to test whether the data support or refute the research hypothesis, it needs to be translated into a statistical hypothesis. A statistical hypothesis is given in statistical terms. Technically, in the context of inferential statistics, it is a statement about one or more parameters that are measures of the populations under study. Statistical hypotheses often are given in quantitative terms, for example: "The mean reading achievement of the population of third-grade students taught by Method A equals the mean reading achievement of the population taught by Method B." Therefore we can say that statistical hypotheses are, concerned with populations under study. We use inferential statistics, to draw conclusions about population values even though we have access to only a sample of participants. In order to use inferential statistics, we need to translate the research hypothesis into a testable form, which is called the null hypothesis. An alternative or declarative hypothesis indicates the situation corresponding to when the null hypothesis is not true. The stated hypothesis will differ depending on whether or not it is a directional research hypothesis.

- **Declarative hypothesis:** When the researcher makes a positive statement about the outcome of the study, the hypothesis takes the declarative form. For example, the hypothesis: "The academic achievement of extroverts is significantly higher than that of the introverts," is stated in the declarative form. In such a statement of hypothesis, the researcher makes a prediction based on his theoretical formulations of what should happen if the explanations of the behaviour he has given in his theory are correct.

- **Null hypothesis:** In the null form, the researcher makes a statement that no relationship exists. The hypothesis, "There is no significant difference between the academic achievement of high school athletes and that of non athletes," is an example of null hypothesis. Since null hypotheses can be tested statistically, they are often termed as statistical hypotheses. They are also called the testing hypotheses when declarative hypotheses are tested statistically by converting them into null form. It states that even where it seems to hold good it is due to mere chance. It is for the researcher to reject the null hypothesis by showing that the outcome mentioned in the declarative hypothesis does

occur and the quantum of it is such that it cannot be easily dismissed as having occurred by chance.

- **Question form hypothesis:**

In the question form hypothesis, a question is asked as to what the outcome will be instead of stating what outcome is expected. Suppose a researcher is interested in knowing whether programmed instruction has any relationship to test anxiety of children.

The declarative form of the hypothesis might be: "Teaching children through the programmed instruction material will decrease their test anxiety".

The null form would be: "teaching children through programmed instruction material will have no effect on their test anxiety.' This statement shows that no relationship exists between programmed instruction and test anxiety.

The question form puts the statement in the form: "Will teaching children through programmed instruction decrease their test anxiety?"

3.6 Formulating Hypotheses

Formulating hypotheses involves more than mere speculation; it requires a blend of informed guesswork and creative reasoning. Hypotheses are not random guesses but are grounded in a combination of existing knowledge and theoretical insight. While there are no strict rules for developing hypotheses, certain conditions can enhance the process. Here are some key factors to consider:

1. Richness of Background Knowledge:

A well-informed researcher is better equipped to formulate hypotheses. Background knowledge allows researchers to observe behaviors, detect trends, and identify probable relationships. For instance, a classroom teacher, observing daily student behavior, might formulate a hypothesis linking student actions to teaching methods or changes in the school environment. This hypothesis is grounded in the teacher's rich experience and understanding of the educational context. Effective hypothesis formulation requires familiarity with existing research and knowledge, ensuring that new insights build upon established facts.

2. Versatility of Intellect:

The formulation of hypotheses often involves deductive reasoning, where hypotheses are derived from existing theories. Deductive hypotheses emerge from applying symbolic logic or mathematical frameworks to a theory. This process requires a versatile intellect capable of synthesizing information and creatively restructuring experiences. Researchers must immerse themselves in relevant information and adopt a thoughtful, imaginative approach to hypothesis development. This involves exploring various paths, maintaining consistency, and integrating knowledge from diverse sources.

3. Use of Analogy and Other Techniques:

Analogies can be a useful tool in hypothesis formulation. By comparing a new situation with an analogous previous situation, researchers can infer potential relationships between variables. For example, if a new educational scenario resembles a past situation with certain known outcomes, the researcher might hypothesize that similar relationships apply. However, analogies should be used cautiously, as they are not infallible. Engaging in discussions with colleagues and experts from various fields can also provide valuable insights and refine hypotheses.

3.8 CHARACTERISTICS OF A GOOD HYPOTHESIS

Hypothesis must possess the following characteristics:

i) Hypothesis should be clear and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.

ii) Hypothesis should be capable of being tested. Some prior study may be done by researcher in order to make hypothesis a testable one. A hypothesis "is testable if other deductions can be made from it which, in turn, can be confirmed or disproved by observation."

iii) Hypothesis should state relationship between variables, if it happens to be a relational hypothesis.

iv) Hypothesis should be limited in scope and must be specific. A researcher must remember that narrower hypotheses are generally more testable and he should develop such hypotheses.

v) Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned. But one must remember that simplicity of hypothesis has nothing to do with its significance.

vi) Hypothesis should be consistent with most known facts i.e. it must be consistent with a substantial body of established facts. In other words, it should be one which judges accept as being the most likely.

vii) The hypotheses selected should be amenable to testing within a reasonable time. The researcher should not select a problem which involves hypotheses that are not agreeable to testing within a reasonable and specified time. He must know that there are problems that cannot be solved for a long time to come. These are problems of immense difficulty that cannot be profitably studied because of the lack of essential techniques or measures.

viii) Hypothesis must explain the facts that gave rise to the need for explanation. This means that by using the hypothesis plus other known and accepted generalizations, one should be able to deduce the original problem condition. Thus hypothesis must actually explain what it claims to explain, it should have empirical reference.

3.9 HYPOTHESIS TESTING AND THEORY

When the purpose of research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of the experimental design or of the non-experimental design.

Research in which the independent variable is manipulated is termed 'experimental hypothesis-testing research' and a research in which an independent variable is not manipulated is called 'non- experimental hypothesis-testing research'.

Let us get acquainted with relevant terminologies used in hypothesis testing.

Null hypothesis and alternative hypothesis:

In the context of statistical analysis, we often talk about null hypothesis and alternative hypothesis. If we are to compare method A with method B about its superiority and if we proceed on the assumption that both methods are equally good, then this assumption is termed as the null hypothesis. As against this, we may think that the method A is superior or the method B is inferior, we are then stating what is termed as alternative hypothesis. The null hypothesis is generally symbolized as H0 and the alternative hypothesis as Ha. The null hypothesis and the alternative hypothesis are chosen before the sample is drawn. Generally, in hypothesis testing we proceed on the basis of null hypothesis, keeping the alternative hypothesis in view. Why so? The answer is that on the assumption that null hypothesis is true, one can assign the probabilities to different possible sample results, but this cannot be done if we proceed with the alternative hypothesis. Hence the use of null hypothesis (at times also known as statistical hypothesis) is quite frequent.

a) **The level of significance:** This is very important concept in the context of hypothesis testing. It is always some percentage (usually 5%) which should be chosen with great care, thought and reason. In case we take the significance level at 5 per cent, then this implies that H0 will be rejected when the sampling result (i.e. observed evidence) has a less than 0.05 probability of occurring if H0 is true. In other words, the 5 percent level of significance means that researcher is willing to take as much as 5 percent risk of rejecting the null hypothesis when it (H0) happens to be true. Thus the significance level is the maximum value of the probability of rejecting H0 when it is true and is usually determined in advance before testing the hypothesis.

b) **The criteria for rejecting the null hypothesis may differ:** Sometimes the null hypothesis is rejected only when the quantity of the outcome is so large that the probability of its having occurred by mere chance is 1 time out of 100. We consider the probability of its having occurred by chance to be too little and we reject the chance theory of the null hypothesis and take the occurrence to be due to a genuine tendency. On other occasions, we may be bolder and reject the null hypothesis even when the quantity of the reported outcome is likely to occur by chance 5 times out of 100.Statistically the former is known as the rejection of the null hypothesis at 0.1 level of significance and the latter as the rejection at 0.5 level. It may be pointed out that if the researcher is able to reject the null hypothesis, he cannot directly uphold the declarative hypothesis. If an outcome is not held to be due to chance, it does not mean that it is due to the very cause and effect relationship asserted in the particular declarative statement. It may be due to something else which the researcher may have failed to control.

c) **Decision rule or test of hypothesis:** Given a hypothesis H0 and an alternative hypothesis Ha we make a rule which is known as decision rule according to which we accept H0 (i.e. reject Ha) or reject H0 (ie. accept Ha). For instance, if H0 is that a certain lot is good (there are very few defective items in it) against Ha that the lot is not good (there are too many defective items in it), then we must decide the number of items to be tested and the criterion for accepting or rejecting the hypothesis. We might test 10 times in the lot and plan our decision saying that if there are none or only 1 defective item among the 10, we will accept H0 otherwise we will reject H0 (or accept Ha). This sort of basis is known as decision rule.

d) **Two-tailed and One-tailed tests:** In the context of hypothesis testing, these two terms are quite important and must be clearly understood. A two-tailed test rejects the null hypothesis if, say, the sample mean is significantly higher or lower than the hypothesized value of the mean of the population. Such a test is appropriate when the null hypothesis is some specified value and the alternative hypothesis is a value not equal to the specified value of the null hypothesis. In a two-tailed test, there are two rejection regions, one on each tail of the curve which can be illustrated as under:

If the significance level is 5 per cent and the two-tailed test is to be applied, the probability of the rejection area will be 0.05 (equally divided on both tails of the curve as 0.025) and that of the acceptance region will be 0.95

But there are situations when only one-tailed test is considered appropriate. A one-tailed test would be used when we are to test, say, whether the population mean is either lower than or higher than some hypothesized value. We should always remember that accepting H0, on the basis of sample information does not constitute the proof that H0, is true. We only mean that there is no statistical evidence to reject it.

Check your progress

11. What is a research hypothesis?
12. What distinguishes a directional hypothesis from a non-directional hypothesis?
13. What is the purpose of a statistical hypothesis?
14. What does a one-tailed test evaluate compared to a two-tailed test?
15. How does a declarative hypothesis differ from a null hypothesis?

3.10 ERRORS IN TESTING OF HYPOTHESIS

Type I and Type II errors: in the context of testing of hypotheses, there are basically two types of errors we can make. We may reject H0 when H0 is true and we may accept H0 when in fact H0 is not true. The former is known as Type I error and the latter as Type II error. In other words, Type I error means rejection of hypothesis which should have been accepted and Type II error means accepting the hypothesis which should have been rejected. Type I error is denoted by (alpha) known as (alpha) error, also called the level of significance of test; and Type II error is denoted by ß (beta) known as ß error. In a tabular form the said two errors can be presented as follows:

Table 3.1: Decision Matrix

	Accept H_0	Reject H_0
H_0 (true)	Correct Decision	Type I Error (α error)
H_0 (false)	Type II Error (β error)	Correct Decision

Type I Error (α Error):

The probability of a Type I error, also known as α, is the likelihood of rejecting a true null hypothesis (H_0). This probability is typically set in advance and represents the level of significance for the hypothesis test. For example, if α is set at 5%, there is a 5% chance of incorrectly rejecting H_0 when it is actually true. By reducing α to a lower level, such as 1%, we limit the probability of making a Type I error to 1%, but this adjustment comes with implications for Type II error.

Type II Error (β Error):

The probability of a Type II error, or β, is the chance of failing to reject a false null hypothesis. Reducing the probability of Type I error (α) generally increases the probability of Type II error (β), and vice versa. This trade-off occurs because lowering α makes it harder to reject H_0, which increases the risk of missing a false null hypothesis.

Balancing Errors:

In practice, the acceptable level of Type I and Type II errors is determined based on the context and consequences of each type of error. For example, in a business scenario, a Type I error might involve unnecessary rework of a product, while a Type II error might risk severe consequences like harming users. Decision-makers must weigh the costs and implications of both types of errors and choose a balance that minimizes overall risk. If the cost of a Type II error (e.g., safety issues) is significantly higher than that of a Type I error (e.g., rework), then a higher α level might be preferred to reduce the risk of Type II errors. Thus, hypothesis testing requires careful consideration to strike an adequate balance between Type I and Type II errors.

It is important for the researcher to formulate hypotheses before data are gathered. This is necessary for an objective and unbiased study. It should be evident from what you have read so far that in order to carry out research; you need to start by identifying a question which demands an answer, or a need which requires a solution. The problem can be generated either by an initiating idea, or by a perceived problem area. We also studied that there are important qualities of hypotheses which distinguish them from other forms of statement. A good hypothesis is a very useful aid to organizing the research effort. It specifically limits the enquiry to the interaction of certain variables; it suggests the methods appropriated for collecting, analyzing and interpreting the data; and the resultant confirmation or rejection of the hypothesis through empirical or experimental testing gives a clear indication of the extent of knowledge gained. The hypothesis must be conceptually clear. The concepts utilized in the hypothesis should be clearly defined – not only formally but also if possible, operationally. Hypothesis testing is the often used strategy for deciding whether a sample data offer such support for a hypothesis that generalization can be made. Thus hypothesis testing enables us to make probability statements about population parameter(s).

3.11 Let us sum up

This chapter provides a thorough exploration of the role of hypotheses and variables in research. It starts by defining different types of variables, such as independent, dependent, extraneous, intervening, and moderator, which play crucial roles in shaping research outcomes. The discussion then shifts to the various types of hypotheses—research, directional, non-directional, null, statistical, and question form—highlighting how each type serves a unique purpose in guiding research. Formulating hypotheses involves a blend of background knowledge, creative thinking, and careful reasoning, with an emphasis on making hypotheses clear, testable, and aligned with existing knowledge. The chapter also addresses the practical side of hypothesis testing, including how to manage errors and make decisions based on statistical evidence. Overall, it offers a practical guide to understanding and applying hypotheses and variables effectively in research.

3.12 Further reading

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3.13 Answer to check your progress

1. A variable is any entity that can take on different values, such as age or country, which can vary among individuals or over time.

2. In a study on self-esteem and social studies performance, intelligence could be an extraneous variable because it might affect performance but is not the main focus of the study.

3. A moderator variable influences the strength or direction of the relationship between an independent and a dependent variable, often producing varying effects depending on its levels.

4. A constant remains the same across all observations or conditions in a study, while a variable can change and take on different values. For example, grade level might be a constant in a study of teaching methods, whereas teaching method is a variable.

5. An independent variable is manipulated or controlled to observe its effect, while a dependent variable is measured to see how it changes in response to the independent variable.

6. The word "hypothesis" originates from the Greek word hypotithenai, meaning "to put under" or "to suppose."

7. In experimental research, hypotheses guide predictions about the results and expected outcomes of the experiment.

8. Hypotheses facilitate knowledge extension, provide rational statements, direct research efforts, and offer a framework for reporting conclusions.

9. Prior empirical research findings are a common source for generating new hypotheses.

10. Intuition, especially from seasoned researchers, uses deep experience and knowledge to formulate hypotheses.

11. A research hypothesis is a predictive statement that relates an independent variable to a dependent variable, and it must be testable.

12. A directional hypothesis specifies the direction of the expected difference or relationship, while a non-directional hypothesis does not specify the direction.

13. A statistical hypothesis is used to test a research hypothesis in statistical terms, involving statements about population parameters.

14. A one-tailed test evaluates whether a population mean is either lower or higher than a hypothesized value, while a two-tailed test evaluates if the mean is significantly different from the hypothesized value in either direction.

15. A declarative hypothesis makes a positive statement about the expected outcome, while a null hypothesis states that no relationship or difference exists.

3.14 Model Questions

1) Explain the concept of variables in research. Discuss the different types of variables, including independent, dependent, extraneous, intervening, and moderator variables, and provide examples of each in a research context.

2) Describe the meaning and importance of hypotheses in research. How does a hypothesis help in designing a study, and what role does it play in guiding the research process?

3) Differentiate between directional and non-directional hypotheses. Provide examples of each type and discuss how they influence the formulation and testing of research hypotheses.

4) Discuss the process of formulating hypotheses. What factors contribute to the development of a well-informed hypothesis, and how can background knowledge, versatility of intellect, and the use of analogies aid in this process?

5) Outline the characteristics of a good hypothesis. How do clarity, testability, specificity, simplicity, consistency with known facts, and the ability to explain the facts contribute to the effectiveness of a hypothesis?

6) Examine the trade-offs between Type I and Type II errors in hypothesis testing. How can researchers manage these errors, and what considerations should be made when deciding on the acceptable level of significance?

7) Describe the different types of hypotheses, including statistical, declarative, null, and question form hypotheses. How do these forms differ in their application and interpretation in research studies?

8) Explain the significance of null and alternative hypotheses in statistical analysis. How are these hypotheses formulated, and what is their role in hypothesis testing? Provide examples to illustrate your explanation.

9) Discuss the concepts of one-tailed and two-tailed tests in hypothesis testing. When should each type of test be used, and how do they differ in terms of significance levels and rejection regions?

10) Describe the various sources of hypotheses in research. How can a review of similar studies, examination of data, discussions with colleagues, exploratory personal investigation, intuition, and rational induction contribute to hypothesis development?

11) Explain the steps involved in hypothesis testing and theory. How does the level of significance influence the testing process, and what criteria are used to reject or accept null hypotheses?

12) Analyze the role of hypothesis testing in experimental and non-experimental research designs. How does the manipulation of independent variables differ in these two approaches, and what impact does this have on hypothesis testing?

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Unit 4
SAMPLING

Unit Structure

4.0 LEARNING OBJECTIVES:

- ✓ To define the terms universe, sample, and sampling.
- ✓ To explain the need for sampling in research.
- ✓ To list the advantages and disadvantages of sampling.
- ✓ To identify the characteristics of a good sample.
- ✓ To differentiate between various techniques of sampling.
- ✓ To describe the types of probability sampling and non-probability sampling.

4.1 INTRODUCTION:

The researcher is concerned with the generalizability of the data beyond the sample. For studying any problem it is impossible to study the entire population. It is therefore convenient to pick out a sample out of the universe proposed to be covered by the study. The process of sampling makes it possible to draw valid inferences or generalizations on the basis of careful observation of variables within a small proportion of the population.

4.2 CONCEPT OF UNIVERSE, SAMPLE AND SAMPLING:

Universe or Population: This term refers to the entire set of objects, individuals, or units about which inferences are to be made in a sampling study. It encompasses every member of the group under investigation, from which the sample is drawn for observation and analysis.

Types of population:

I. Target population: The target population refers to the entire group that researchers aim to understand and analyze. This population is typically defined by specific characteristics that align with the study's objectives. For instance, if a study focuses on high school teachers across a country, the target population would include all such teachers, encompassing various educational settings and backgrounds. The target population serves as the foundation for generalizing the study's results, allowing researchers to draw broad conclusions and make informed recommendations.

II. Accessible population: On the other hand, the accessible population is the segment of the target population that researchers can realistically study, often due to practical constraints like time, budget, and geographic accessibility. For example, if logistical challenges prevent studying the entire national population of teachers, researchers might focus on teachers within a specific district. This accessible population ensures that data collection is feasible while still maintaining the study's relevance and applicability. By clearly defining both the target and accessible populations, researchers can ensure that their studies are both practical and meaningful, ultimately enhancing the reliability and impact of their findings.

Sample: A sample is a subset or part of the population selected for the purpose of study. It represents the larger population and is used to gather information about some of its members to make inferences about the whole population.

Sampling: Sampling is the process of selecting a subset (sample) from the population. To do this, the population is divided into distinct groups known as sampling units, from which the sample is drawn.

4.3 NEED FOR SAMPLING:

- Efficiency with Large Populations: Sampling allows researchers to study a representative subset of a large population, making the process more manageable and efficient.

- Cost-Effectiveness: By focusing on a sample rather than the entire population, researchers can save time, money, and resources.

- Feasibility with Homogeneous Units: Sampling is particularly useful when the population units are relatively homogeneous, which means that studying a sample can effectively reflect the characteristics of the entire population.

- Practicality in Limited Accuracy Requirements: Sampling is suitable when precise data is not necessary, allowing for estimates and approximations rather than exact figures.

- Handling Unlimited Data: Sampling provides a method to manage and analyze data when dealing with vast or infinite datasets that are impractical to examine in full.

- Improved Data Quality: Sampling can enhance the quality of data collected by focusing resources on carefully chosen subsets, leading to more accurate and reliable results.

- Faster Data Collection: Gathering data from a sample can be quicker than attempting to collect information from every member of the population, accelerating the research process.

- Enhanced Analytical Precision: With a well-chosen sample, researchers can apply statistical techniques to infer characteristics about the population with greater precision and reduced error.

Check your progress

1. What is a sample in the context of a sampling study?
2. Why is sampling considered cost-effective in research?
3. What is the main advantage of using sampling with large populations?

4.4 ADVANTAGES AND DISADVANTAGES OF SAMPLING:

Advantages of Sampling:

- Economical: Sampling reduces costs compared to studying the entire population by focusing on a manageable subset, which lowers expenses related to data collection and analysis.

- Increased Speed: Research processes, including data collection, analysis, and interpretation, are expedited with a sample, as it requires less time than examining the whole population.

- Greater Scope: Handling and managing data become more feasible with a sample, offering a broader scope and greater flexibility in research. This allows for more detailed and focused analysis.

- Accuracy: With a smaller, well-chosen sample, research can achieve higher levels of completeness and accuracy. This focused approach ensures precise data processing and more authentic results.

- Improved Rapport: Working with a sample allows researchers to establish better rapport with respondents, which enhances the validity and reliability of the collected data.

Disadvantages of Sampling:

- Bias Risk: There is a risk of biased selection, which can lead to erroneous conclusions. Bias may arise from an inadequate sampling method or the inherent nature of the phenomenon under study.

- Difficulty in Selecting a True Representative Sample: For complex research problems, it can be challenging to select a truly representative sample. If the sample is not representative, the results may be inaccurate and less useful.

- Need for Specialized Knowledge: Effective sampling requires expertise in sampling techniques, statistical analysis, and error estimation. Inadequate knowledge or training can lead to significant mistakes and unreliable results.

- Changeability of Units: If the population units are not homogeneous, the sampling process may become unscientific. Additionally, issues such as unavailability or non-cooperation of individuals can necessitate replacements, introducing variability into the study.

- Impossibility of Sampling: In cases where the population is too small or too heterogeneous, it may be impossible to select a representative sample. In such instances, a census study (collecting information from every member of the population) may be necessary. Sampling errors can also occur due to the high expectations for accuracy.

4.5 CHARACTERISTICS OF A GOOD SAMPLE:

- True Representation: The sample should accurately represent the population, reflecting its key characteristics and diversity.
- Bias-Free: The sample must be free from biases that could skew results and lead to erroneous conclusions.
- Sufficient Size: The sample size should be adequate to ensure reliability and validity of the results, providing a robust basis for analysis.
- Independent and Relevant Units: Each unit within the sample should be independent of others and relevant to the study objectives, ensuring the validity of the data collected.
- Complete, precise and Up-to-Date: The sample units should be complete, precise, and current to maintain the accuracy and relevance of the findings.
- Free from Random Sampling Error: Efforts should be made to minimize random sampling errors, ensuring the sample provides a true reflection of the population.
- Avoidance of Substitution: The original sample should not be replaced for convenience; any substitutions should be carefully considered to avoid compromising the integrity of the sample

4.6 TECHNIQUES OF SAMPLING:

There are different types of sampling techniques based on two factors viz. (1) the representation basis and (2) the element selection technique on the representation basis. The sample may be probability sampling or it may be non-probability sampling. On the element basis, the sample may be either unrestricted or restricted. Here we will discuss about two types of sampling viz.

(a) Probability Sampling and

(b) Non-Probability Sampling.

Difference between Probability and Non- Probability Sampling:

(1) A probability sample is one in which each member of the population has an equal chance of being selected but in a non- probability sample, a particular member of the population being chosen is unknown.

(2) In probability sampling, randomness is the element of control. In non-probability sampling, it relies on personal judgment.

Check your progress

4. What is a major advantage of using sampling in research?

5. What is a key disadvantage of sampling?

6. What characteristic is essential for a good sample?

4.7 TYPES OF PROBABILITY SAMPLING:

Following are the types of probability sampling

1) Simple random sampling: Every member of the population has an equal chance of being selected. This can be achieved through methods like random number generators or drawing names from a hat. It's straightforward but can be impractical for large populations.

Example: Suppose you want to conduct a survey on student satisfaction at a university. You have a list of all 5,000 students. To ensure every student has an equal chance of being selected, you use a random number generator to pick 300 students from the list. Each student in the list has a 1 in 5,000 chance of being included in the sample, and this method ensures a truly random selection.

2) Systematic sampling: Members of the population are selected at regular intervals. For instance, every 10th person in a list may be chosen. This method is easier to administer than simple random sampling but can introduce bias if there is a hidden pattern in the list.

Example: Imagine you need to sample employees from a large company with 1,000 employees to assess job satisfaction. You decide to select every 10th employee from a list ordered by employee ID number. Starting from a random position, such as the 5th employee on the list, you then select every 10th employee (15th, 25th, 35th, etc.). This results in a sample of 100 employees. This method is simpler and quicker than simple random sampling but may be biased if there is a systematic pattern in the list.

3) Stratified sampling: The population is divided into distinct subgroups or strata (e.g., age, income), and a random sample is taken from each stratum. This technique ensures that all subgroups are represented proportionately in the sample, enhancing the accuracy of the results.

Example: You want to study customer satisfaction across different store branches of a retail chain. The chain has 10 branches, each with varying customer demographics. You divide

the population of customers into strata based on the branch they visit. From each branch (stratum), you randomly select customers proportional to the number of customers in that branch. For instance, if Branch A has 20% of the total customer base, you will select 20% of your sample from Branch A. This ensures that each branch is proportionately represented in your sample.

4) Cluster sampling: The population is divided into clusters (e.g., geographical areas), and a random sample of clusters is selected. All individuals within the chosen clusters are then sampled. This method is cost-effective for large populations but may have higher variability.

Example: Suppose you are conducting a health survey in a country with 100 cities. Instead of sampling individuals from the entire population, you randomly select 10 cities (clusters). Within each selected city, you then sample households and individuals. For example, if you choose New York, Los Angeles, and Chicago, you would conduct the survey only in these cities, sampling from their respective populations. This method is cost-effective and practical for large geographic areas but can introduce variability if the selected clusters are not representative of the entire population.

5) Multi stage sampling: Multi-Stage Sampling is a complex sampling technique used to manage large, dispersed populations by selecting samples in several stages. This method involves first selecting large clusters and then progressively narrowing down to smaller units until a final sample is obtained. It is particularly useful when the population is spread over a wide geographic area or when a comprehensive list of the entire population is not available.

Example: Suppose you are conducting a national survey to evaluate student performance in different regions of the country.

Stage 1: Select Primary Units (Regions)

The country is divided into 15 regions. You randomly select 5 regions for the survey, such as Region A, Region B, Region C, Region D, and Region E.

Stage 2: Select Secondary Units (Schools)

Within each selected region, you identify all the schools and then randomly select 8 schools from each region. For instance, in Region A, you select schools X, Y, Z, and 5 others.

Stage 3: Select Final Units (Students)

From each of the 40 selected schools (8 from each region), you randomly select 25 students to participate in the survey. For example, at School X, you choose 25 students to complete the survey.

4.8 TYPES NON-PROBABILITY SAMPLING:

Non-probability sampling methods do not provide each member of the population with a known or equal chance of being included in the sample. These techniques are often used when probability sampling is not feasible, and they include:

A) Purposive Sampling: Purposive Sampling, also known as judgmental or selective sampling, involves deliberately selecting individuals who possess specific characteristics or qualities relevant to the research study. The researcher targets a "typical" group that is believed to represent the larger population.

Example: If a researcher aims to understand the challenges faced by teachers in low-income schools, they might choose to survey teachers working in municipal schools serving students from economically disadvantaged backgrounds. The assumption here is that teachers in these schools are representative of all teachers working with students from lower socio-economic strata, thus providing insights into the broader population of interest.

B) Convenience Sampling: Convenience Sampling involves selecting individuals who are easiest to reach or most readily available to participate in the study. This method is often used for its simplicity and practicality but may introduce bias as the sample may not be representative of the entire population.

Example: A researcher needs to gather opinions from college students about a new campus policy. They choose to survey students who are present in the campus cafeteria at a specific time. The sample consists of students who are conveniently available at that location and time, rather than a random selection of all students.

C) Quota Sampling: Quota Sampling is a technique where the researcher divides the population into subgroups and then selects samples from each subgroup based on predetermined quotas. This method ensures that specific characteristics are represented in the sample, but the selection within each subgroup is non-random.

Example: To study television viewing habits, a researcher decides to gather data from 40 adults and 20 adolescents. They ensure representation by selecting 20 adult men, 20 adult women, 10 adolescent girls, and 10 adolescent boys. The researcher picks individuals based on their availability, ensuring the sample reflects the proportions of each subgroup.

D) Snowball Sampling: Snowball Sampling is used to identify participants through referrals from initial subjects. This technique is particularly useful for accessing hard-to-reach

populations or individuals with specific characteristics. The sample grows like a "snowball" as existing subjects recruit new subjects.

Example: A researcher studying rare medical conditions starts by identifying a few patients who have the condition. After collecting data from these initial subjects, they ask them to refer other individuals with the same condition. This process continues as each new participant provides additional referrals, expanding the sample.

Check your progress

8. What is simple random sampling?

9. What is the main characteristic of stratified sampling?

10. What is a key feature of snowball sampling?

11. How does cluster sampling differ from simple random sampling?

4.9 Validity and Reliability in Educational Research

Validity and reliability are crucial concepts in educational research, ensuring the accuracy and consistency of findings. Validity refers to the extent to which a research study or instrument measures what it intends to measure. There are several types of validity, each addressing different aspects of accuracy.

Content validity ensures that the research covers all relevant aspects of the subject matter. For example, a math test should include questions from all relevant topics, such as algebra and geometry, to truly reflect students' knowledge. Experts often evaluate content validity by reviewing the test items to confirm comprehensive coverage.

Construct validity examines whether the test accurately measures the theoretical construct it claims to assess. This can be evaluated through methods like factor analysis or by correlating the test with other measures of the same construct. For instance, a scale designed to measure student anxiety should specifically assess anxiety traits and not other emotions.

Criterion-related validity assesses how well one measure predicts an outcome based on another measure. It includes predictive validity, which evaluates how well a test forecasts future performance, such as SAT scores predicting college success. Concurrent validity examines the correlation between the test and an established measure taken at the same time, ensuring similar results.

External validity refers to the generalizability of the research findings beyond the specific study context. Factors like population characteristics, settings, and timeframes can influence external validity. For instance, a study on teaching methods conducted in one school should be applicable to similar schools to have broad relevance.

Reliability, on the other hand, is about the consistency and stability of measurement results over time. A reliable instrument produces consistent results under similar conditions. Test-retest reliability measures the stability of test scores by administering the same test to the same subjects at different times and checking for consistency. Inter-rater reliability evaluates the agreement between different observers or raters assessing the same phenomenon. For example, multiple teachers grading essays should yield similar scores to demonstrate reliability. Internal consistency assesses how well the items within a test measure the same construct, often evaluated using Cronbach's alpha.

Enhancing validity and reliability involves several strategies. Conducting pilot testing helps refine instruments and identify potential issues. Clearly defining constructs and variables improves measurement accuracy. Training raters ensures consistent data collection, and using triangulation—employing multiple methods or data sources—corroborates findings and strengthens research.

Validity and reliability are foundational to the integrity of educational research. They ensure that findings are accurate, consistent, and applicable, enabling researchers to draw confident conclusions that inform educational practices and policies.

Check your progress

12. What does validity in educational research ensure?

13. Give an example of content validity.

14. What is test-retest reliability?

4.10 LET US SUM UP

This chapter covers the essentials of sampling techniques used to gather data from large populations efficiently. It starts by defining key terms like universe, sample, and sampling, emphasizing why sampling is crucial for saving time, reducing costs, and managing data effectively. While sampling can offer significant advantages like cost savings and quicker results, it also comes with challenges, such as potential biases and ensuring the sample accurately represents the broader population. A good sample should be representative,

unbiased, and appropriately sized. The chapter contrasts probability sampling methods (like simple random and stratified sampling) with non-probability methods (such as purposive and convenience sampling), highlighting that choosing the right technique is key to obtaining reliable and meaningful research results.

4.11 Further Reading

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4. 12 Answer to check your progress

1. A sample is a subset of the population selected for study to make inferences about the entire group.
2. Sampling saves time, money, and resources by focusing on a subset rather than the entire population.
3. It makes the research process more manageable and efficient by studying a representative subset.
4. It reduces costs by focusing on a manageable subset of the population.
5. There is a risk of bias, which can lead to erroneous conclusions.
6. A good sample should be a true representation of the population.
7. Every member of the population has an equal chance of being selected.
8. The population is divided into subgroups, and a random sample is taken from each.
9. Participants are recruited through referrals from initial subjects.
10. It involves selecting entire clusters and sampling all individuals within them.

11. Validity ensures that a research study or instrument accurately measures what it intends to measure.
12. A math test including questions from all relevant topics, such as algebra and geometry.
13. Test-retest reliability measures the consistency of test scores over time by administering the same test to the same subjects at different times.

4.13 Model Questions

1. Explain the importance of sampling in research and its role in generalizing data beyond the sample.
2. Describe the concepts of universe, sample, and sampling in a research study. How do they relate to each other?
3. Discuss the need for sampling in research, highlighting its advantages in terms of efficiency and practicality.
4. Analyze the advantages and disadvantages of sampling. How do these factors influence the reliability of research findings?
5. What are the characteristics of a good sample? Discuss how each characteristic contributes to the validity of research.
6. Compare and contrast probability and non-probability sampling techniques, providing examples of each.
7. Discuss the different types of probability sampling methods. How does each method ensure randomness and representation?
8. Explain the process of systematic sampling and its potential biases. How can these biases be minimized?
9. Describe stratified sampling and its advantages in ensuring representation of subgroups within a population.
10. Illustrate the concept of cluster sampling with examples. What are the benefits and drawbacks of using this method?
11. Evaluate the use of multi-stage sampling in complex surveys. What are the steps involved, and how does it enhance data collection?
12. Explore the different non-probability sampling methods and their applications in research. How do these methods address the limitations of probability sampling?
13. Discuss the different types of validity in educational research and explain their importance in ensuring accurate study results. Provide examples to illustrate each type.

14. Explain the concept of reliability in educational research. Describe the various types of reliability and discuss strategies to enhance reliability in research studies, including examples.

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