UNIT 1: EDUCATIONAL MEASUREMENT

UNIT STRUCTURE

1.1 Learning Objectives

1.2 Introduction

1.3 Meaning of Measurement

1.3.1 Types of Measurement

1.4 Meaning of Educational Measurement

1.5 Nature of Educational Measurement

1.6 Functions of Educational Measurement

1.7 Scales of Measurement

1.8 Let Us Sum Up

1.9 Further Reading

1.10 Answer to Check Your Progress

1.11 Model Questions

1.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- understand the meaning and types of Measurement
- define and explain the nature of Educational Measurement
- explain the functions of Educational Measurement
- explain the different levels or scales of Measurement

1.2 INTRODUCTION

Measurement is an indispensable part of human life. Almost all aspects of our daily life are touched by measurement of different forms. Ross & Stanley, in their book Measurement in today's schools wrote, "From birth to death almost every aspect of our daily lives is touched by measurement in its numerous forms. At birth the record of that important event is carefully made according to the nurse's watch. During the next few days measurements of the baby's weight and temperature are part of the daily routine of the hospital. Ever afterward, whether in school or outside,

watches, clocks, balances, thermometers, money systems, and other forms of measurement play prominent roles in the life of every human being." Thus, measurement, in its various forms, controls man's life to a great extent. Day-to-day activities like buying and selling, cooking, stitching, constructing, diagnosing diseases and using medicines, and numerous other such acts require measurement in its different forms. Hence, the concept of measurement is neither new nor difficult for us. In this unit we are going to discuss the entire concept of measurement in education.

1.3 MEANING OF MEASUREMENT

In simple word, measurement is the act or process of ascertaining the size, dimensions, amount, degree, or quantity of something. It is a process by which some characteristic of an individual or some object or event is presented in the form of some number or symbol according to specified rule(s). Measurement ascertains dimensions such as: big or small; much or less; long or short; high or low; of an object, event or other phenomena. Different units such as kilogram, meter, foot, inch, etc. and various tools such as weighing scale, thermometers, measuring tapes etc. are used for making different types of measurement. For example, in order to measure the physical dimensions such as the length, breadth and height of a classroom, tools like a measuring tape or rule is required and the measurement is expressed in units like meter, foot, or inches.

Psychometricians have put forward many definitions of measurement in order to explain the meaning of measurement. Some of the popular definitions have been presented below:-

- According to **S.S. Stevens**, "Measurement means assignment of numbers to objects or events according to rules".
- According to **James M. Bradfield**, "Measurement is the process of assigning symbols to dimensions in order to characterize the status of a phenomenon as precisely as possible".
- **Guilford** says, "Measurement means the description of data in terms of numbers and this, in turn, means taking advantage of the many

benefits that operations with numbers and mathematical thinking provide".

Thus, measurement means quantification of data. It involves the process of presenting some object, event, or their characteristics in symbolic or numeric form. Objects, events, or their characteristics are made more comprehensible by the way of comparing them with the units used for making measurement.

1.3.1 Types of Measurement

Measurement touches the life of everyone in different fields of day to day activities. However, the nature and purpose of all measurement is not the same. For example, the measurement of the dimensions of a room differs vastly in its nature as well in its purpose from the measurement of intelligence or achievement of an individual. Moreover, the former requires the use of physical sciences whereas the latter requires psychological tools. Hence, measurement may be classified into different types on the basis of their purpose, nature, and the tools or methods used. Following are the main types of measurement: -

Physical measurement: Measurement that exists in the physical or material world is known as physical measurement. As the name suggests, this type of measurement is used to measure various physical or material things of the world. The dimensions such as weight, height, length, breadth etc. are measured using units such as gram, meter, foot, etc. which are of definite value and have universal standard. That is why physical measurement is simple and objective. Some important characteristics of physical measurement are:-

- Physical measurement starts from a true zero point. For example, when the length of something is measured to be ten feet, it is implied that the length of the object is ten feet from zero. Zero, in physical measurement, indicates the absolute

absence of the dimension being measured.

- Physical measurement is complete in itself; it is not dependent upon any other thing.
- Physical measurement is direct, definite, and objective.
- In physical measurement, the object or thing being measured can be measured completely.
- The units and the tools of physical measurement are definite, universal, and of the same standard.
- In physical measurement, the units bearing the same name have the same value and hence they can be subjected to direct comparison.

Psychological measurement: Measurement that exists in the psychological or mental world and their characteristics is known as psychological measurement. This type of measurement is generally qualitative measurement. Unlike physical measurement, psychological measurement is indirect, because psychological characteristics or traits are abstract and hence cannot be subjected to direct measurement. Such traits can be measured indirectly only when they find expression in the behaviour of man. That is why psychological measurement is a complex process. Moreover, in the absence of definite and standard units of psychological measurement, this measurement is generally subjective and incomplete. Some of the important characteristics of psychological measurement are: -

- Psychological measurement does not have a true zero point. Zero, in this type of measurement, is not absolute but relative. For example, if an individual scores a zero in an intelligence test, that does not signify absolute or complete absence of intelligence in the individual.
- Psychological measurement is not complete in itself; it is relative and is dependent upon various other factors.
- Psychological measurement is indirect, indefinite, and subjective.
- Psychological measurement is incomplete, because the

psychological trait or characteristic being measured can never be measured completely. For example, in order to measure intelligence of an individual, only a sample of his behaviour can be measured and his total behaviour cannot be measured.

- The tools and units in psychological measurement are not of definite or universal standard. Hence psychological measurement does not have universal acceptability.
- Direct comparison between different measurements is not possible in psychological measurement since tools and units are not of definite or universal standard.

1.4 MEANING OF EDUCATIONAL MEASUREMENT

Education refers to the deliberate effort made to bring desirable change in student behaviour. In order to bring desirable change in student behaviour, selected learning experiences are provided to students using a curriculum in the form of teaching. At the end of teaching, the act of ascertaining or determining the changes (that are thought to have taken place as a result of teaching) in student behaviour is known as educational measurement. In order to ascertain the changes in student behaviour, characteristics of students, such as their knowledge, skills, abilities, and interests are assigned with numbers on the basis of an established set of rules. This process of quantifying the influence or effectiveness of learning experiences in terms of modification of student behaviour may be called educational measurement. Defining the meaning of educational measurement, Indian educationist **R. P. Taneja** wrote, "It is the process of quantifying any human attribute that is pertinent in the context of education."

In brief, educational measurement is the measurement of behavioural change in the field of education. For such measurement collection and systematic organization of data relating to the behaviour of an individual in the field of education is required. For this, the activities such as, construction of various educational tests and their standardization; development of other tools of measurement and their use; etc. are involved.

Measurement of educational achievement, intelligence, interest, ability, aptitude, and other traits of students using various tests and other tools falls within the scope of educational measurement. Thus, educational measurement may be understood as a part of psychological measurement. Because, educational behaviour of man is just a part of general behaviour and for the measurement of which methods and tools of psychological measurement is required. It is noteworthy in this context that educational and psychological measurement is not always accurate and definite unlike physical measurement.



CHECK YOUR PROGRESS

Q 1: What do you mean by measurement?

.....

Q 2: What is the importance of measurement in human life?

.....

1.5 NATURE OF EDUCATIONAL MEASUREMENT

Educational measurement is the measurement of behavioural change in the field of education. Measurement in education is important because educators need to ascertain what the learners already know or what they are capable of doing so that further learning can be planned. Moreover, curriculum or subject matter organization is based on the degree of mastery level of academic content for various grades. Hence, measurement is must for educators to verify that learners have acquired the mastery level of each grade and that they are ready to move on to the next grade or course content.

The famous behaviourist psychologist **E. L. Thorndike** opines that, "Whatever exists at all exists in some amount. To know it thoroughly involves knowing its quantity as well as its quality. Education is concerned with

changes in human beings; a change is a difference between two conditions; each of these conditions is known to us only by the products produced by it - things made, words spoken, acts performed, and the like. To measure any of these products means to define its amount in some way so that competent persons will know how large it is, better than they would without measurement. To measure a product well means so to define its amount that competent persons will know how large it is, with some precision, and that this knowledge may be conveniently recorded and used. This is the general credo of those who, in the last decade, have been busy trying to extend and improve measurements of educational products."

In our day to day life we come across a wide variety of measurements of different things in our environment. However, measurement in education is not always definite and accurate unlike the measurement of physical phenomena. The nature of educational measurement is unique which is revealed through the following characteristics of it:

- Educational measurement refers to the quantitative presentation of different aspects of individual's behaviour and their characteristics in the field of education. In other words, educational measurement is the process of assigning numbers or symbols to individuals or their characteristics according to set rules.
- Educational measurement also refers to the process of testing, scaling, or appraising the outcomes of learning. It includes construction and administration of tools such as tests and scales, their standardization and validation, use of statistical techniques in the interpretation of obtained measures or test scores.
- Quantitative values used in educational measurement indicate the presence, absence, or the intensity of the trait being measured.
- Educational measurement does not start from a true zero point. Zero in educational measurement refers only to a relative position.
- The value of units used in educational measurement is neither constant nor definite. That is why educational measurement is not completely free from the subjective influence of person making the

measurement.

- Numerical data obtained by educational measurement does not convey definite meaning in their primary or crude form. For example, the score of 60 obtained by a student in an examination does not make proper sense unless total marks in the examination, minimum marks required to pass the examination, marks of other students in the same examination; etc. are known.
- Since observation or measurement of all of what a student knows or a student can do is not possible, educational measurement is based on samples of behaviours and hence it is incomplete.
- Educational measurement is indirect and is based on inference. Educational achievement or other characteristics of students cannot be measured directly and must be measured indirectly on the basis of their answers or behaviours in response to the questions asked or tasks assigned to them. Moreover, scores or performance of students in Maths or in English is considered to be the representations of their underlying problem-solving or communication skill. Such inference is conclusion based on the sample of behavior assessed during educational measurement.
- Numerical data obtained from different measurements cannot be subjected to direct comparison since measurement in education is relative and not absolute.

Thus, educational measurement is indirect, indefinite, and subjective unlike physical measurement which is direct, definite, and objective. Though constant attempts have been made to minimize the subjectivity and other limitations of educational measurement by experts, it cannot claim the accuracy and precision that characterizes physical measurement.



CHECK YOUR PROGRESS

Q 3: Write two differences between physical measurement and educational measurement.

.....

Q 4: Write any two limitations of educational measurement.

.....

1.6 FUNCTIONS OF EDUCATIONAL MEASUREMENT

Measurement in education performs various functions, including the main function of estimating change in student behaviour. Measurement in education helps in making decision about retaining or promoting students from one grade to another, besides assessing the effectiveness of teaching and learning. It assesses how effectively the educational objectives have been attained. Some important functions of educational measurement may be discussed as under: -

- **Instructional Function:** Measurement is an indispensable part of teaching and instruction. Measurement helps in the selection of objectives of instruction, their adequacy, and in the determination of their usability. Moreover, measurement is a must for assessing the progress of students towards the achievement of objectives. It also helps in determining the success or failure of teaching methods and strategies. Necessary revision and reform of curriculum is also aided by the process of educational measurement.
- **Selection:** Selection of students for admission into educational institutions and particular courses, decision regarding their promotion or retention, and selecting students for various curricular as well as co-curricular activities on the basis of their interests and aptitudes depend on measurement of various sorts.
- **Classification:** Various educational necessities call for classification

of students on the basis of their abilities, interests, or other criteria. Such classifications may be required for selecting students for admission into different courses or career, forming groups or sections of students of homogenous characteristics, making provision for special instruction or guidance; selecting students for advanced studies and such other purposes. Measurement may be used as a basis for making such classification of students.

- **Comparison:** Educational measurement is essential for making comparison between students on the basis of their achievement, ability, aptitude, intelligence, and other traits or characteristics. Such comparison may help to find out individual differences and the causes of such differences among the students. Educational measurement acts as a basis for making comparison between various schemes of instruction, teaching methods, and strategies etc., in order to find out their relative success or failure.
- **Prediction:** Many decisions in education involve prediction as its basis or foundation. Educational measurement is used as a basis for making predictions as to the success or failure of students in particular course, career or other related areas of activities. Current data obtained by measurement indicate the potential success of students in the future.
- **Diagnosis:** Every individual student coming to an educational institution is different from others which make them unique. Different students have strengths and/or weaknesses in different areas. Measurement is important to diagnose such strengths and weaknesses so that proper measures may be taken for their development. Measurement plays crucial role in helping the selection of any course or career on the basis of students' strengths, and for providing them special training or remedial measures to offset their weaknesses.
- **Guidance:** Guidance is essential for the success of students in their educational, vocational, and personal lives. Lack of proper guidance may lead to failure and frustration in the lives of people.

Guidance is vital to live a successful and complete life, keeping aside the problems of life. Measurement of interests, abilities, and other psycho-physical characteristics of students is indispensable for providing effective guidance to students.

- **Administration:** Measurement is very important for making various administrative decisions in any educational enterprise. Measurement forms the basis for many educational decisions, policy formulation, assessing the effectiveness of administrative measures, preparation of progress report, admission, promotion, and other administrative decisions.
- **Research:** Research is very important to find out the effectiveness of curriculum and teaching methods; suitability of educational objectives and the level of their achievement; effectiveness of educational administration; and to find out means for necessary improvement. Measurement in education helps immensely in the conduct of research for finding solutions to educational problems.
- **Development:** Improvement and development of educational practice and related issues is assisted by measurement in education. Educational measurement is very important for obtaining feedback about the success of teaching-learning and teaching methods, for collecting data to improve learning experiences and teaching strategies, and for making effective schemes of education to achieve the objectives of instruction.



CHECK YOUR PROGRESS

Q 5: What are the main functions of educational measurement?

.....

1.7 SCALES OF MEASUREMENT

Measurement is the process of assigning numbers to objects or

events according to specified rules. As Guilford said, "Measurement means the description of data in terms of numbers and this, in turn, means taking advantage of the many benefits that operations with numbers and mathematical thinking provide". However, in the process of measurement, i.e., in assigning numbers, all statistical or mathematical operations are not always applicable to the measurements (numbers) made. It is here, that the concept of scales or levels of measurement becomes relevant and important. Scales of measurement refer to ways in which numbers (measurements) are defined and categorized. Each scale of measurement has certain properties or attributes which determine its applicability in certain mathematical or statistical analysis. Thus, scales of measurement, also known as the Levels of measurement, is a classification that describes the nature of information within the numbers assigned to variables. Stanley Smith Stevens, who was the Director of the Psycho-acoustic laboratory in Harvard University, developed the classification with four levels, or scales, of measurement. These levels or scales include: nominal, ordinal, interval, and ratio.

- **Nominal scale:** When numerical data or numbers in measurement are used as simple identifiers or names, they represent a nominal scale of measurement. Examples of nominal scale includes: registration numbers of vehicles, PINCODE, phone numbers, etc. Similarly, in a research study where gender is a variable, coding Females as 1 and Males as 2 is another example of nominal data. Here, numbers are used only to represent categories of data.

  Nominal scales are known as qualitative scales, and measurements made on qualitative scales give qualitative data. Numbers used in nominal scales are assigned as labels only and they have no specific numerical value or meaning. That is why mathematical computations cannot be performed on nominal data. From a statistical point of view this is the lowest level of measurement.
- **Ordinal scale:** When numbers used in measurement represent an ordered series of relationships or rank order, they represent an ordinal scale of measurement. Students ranked in a class as first,

second, or third represent ordinal data. Thus, ordinal scale gives information about the rank or order of the measures, but it still does not provide information about the relative difference between the successive intervals on the scale. For example, when three boys are ranked as 1st, 2nd, and 3rd on the basis of their intelligence/ achievement, height/ or any other trait; we cannot say that the difference between 1st ranked and the 2nd ranked is proportionate to the difference between the 2nd ranked and the 3rd ranked boy. Such scaling cannot provide information about the difference between the intervals and they represent a rank ordering of the intervals only. However, this scale is widely used in educational and psychological research.

- **Interval scale:** An interval scale represents quantity, and equal difference between successive intervals on the scale, in addition to the information about their order. A temperature scale is an example of an interval scale. On a Fahrenheit or Celsius scale, a degree represents the same amount of heat wherever it occurs on the scale. The difference between a temperature of 30 and 18 degree Celsius is the same as the difference between 42 and 20 degree Celsius. However, zero represents an additional point of measurement in an interval scale and it does not represent the absolute lowest value. For example, zero degree Celsius on a temperature scale does not signify absolute absence of temperature.
- **Ratio scale:** The ratio scale of measurement also represents quantity and equal difference between intervals with an absolute or true zero. Normally, physical measurements, such as height and weight, represent ratio data. Such measurements invariably refer to definite quantity, where units are equal, and zero means absolute absence of the dimension being measured. All types of statistical measures are applicable to ratio scales.

Following characteristics of the scales of measurement in the **table 1.1 shows the difference between them:**

Table 1.1: Difference among the four Scales of measurement

	Differentiates between variables/measures	Ranks/orders measures	Indicates the degree of difference between measures	Possesses absolute or true zero
Nominal	✓	×	×	×
Ordinal	✓	✓	×	×
Interval	✓	✓	✓	×
Ratio	✓	✓	✓	✓

TO LEARN MORE

Stanley Smith Stevens, who was the Director of the Psycho-acoustic laboratory in Harvard University, developed the classification with four levels, or scales, of measurement. These levels or scales include: Nominal, Ordinal, Interval, and Ratio.



1.8 LET US SUM UP

- Measurement is the process of assigning numbers to objects or events according to rules. It is the act of ascertaining the size, dimensions, amount, degree, or quantity of something.
- Measurement may be classified as physical measurement and psychological measurement on the basis of their purpose, nature, and the tools or methods used.
- Educational measurement is the process of determining the changes in student behaviour that are thought to have taken place as a result of teaching. In other words educational measurement is the process of quantifying the influence of learning experiences in terms of modification of student behaviour.
- Educational measurement, which may be understood as a part of psychological measurement, involves collection and systematic organization of data, construction of tests and their standardization, development of other tools of measurement and their use.
- The scope of educational measurement include measurement of educational achievement, intelligence, interest, ability, aptitude, and other traits of students using various tests and other tools.

- Unlike physical measurement, educational measurement has certain limitations. Educational measurement is indirect, indefinite, and subjective unlike physical measurement which is direct, definite, and objective. Though constant attempts have been made to minimize the subjectivity and other limitations of educational measurement by experts, it cannot claim the accuracy and precision that characterizes physical measurement.
- Measurement in education performs various functions, including the main function of estimating change in student behaviour. Measurement in education helps in selection, classification, comparison, prediction, diagnosis, guidance, besides assessing the effectiveness of teaching and learning.
- There are mainly four scales (viz: nominal scale, ordinal scale, interval scale, and ratio scale) of measurement that refer to ways in which numbers are defined and categorized. Each scale of measurement has certain properties or attributes which determine its applicability in certain mathematical or statistical analyses. Thus, scales of measurement, is a classification that describes the nature of information within the numbers assigned to variables.



1.9 FURTHER READING

1) Anastasi A. (1988): Psychological Testing, McMillan, New York
2) Asthana Bipin (2007): Measurement and Evaluation in Psychology and Education, 9th Ed. Vinod Pustak Mandir, Agra
3) Cronbach, L. J. (1990): Essentials of psychological testing,5th Edition, Harper Collins Publishers: New York
4) Freeman, F.S. (1962): Theory and Practice of Psychological Testing, Holt, Rirehant & Winston, New York
5) Pradhan Hemant (1996): Essentials of Educational Measurement, Evaluation and Statistics, Saha Publishers and Distributers, Sambalpur
6) Stanely, Julian C. & Ross, Clay Campbell (1964): Measurement in today's schools, 4th Edition, Prentice Hall

1.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: Measurement means quantification of data. It is a process by which some characteristic of an individual or some object or event is presented in the form of some number or symbol according to specified rule(s). Measurement ascertains dimensions such as: big or small; much or less; long or short; high or low; of an object, event or other phenomena. According to James M. Bradfield, "Measurement is the process of assigning symbols to dimensions in order to characterize the status of a phenomenon as precisely as possible".

Ans to Q No 2: Measurement is an indispensable part of human life. Almost all aspects of our daily life are touched by measurement. "From birth to death almost every aspect of our daily lives is touched by measurement in its numerous forms". Watches, clocks, balances, thermometers, money systems, and other forms of measurement play prominent roles in the life of every human being. Measurement, in its various forms, controls man's life to a great extent. Day-to-day activities like buying and selling, cooking, stitching, constructing, diagnosing diseases and using medicines, and numerous other such acts require measurement in its different forms.

Ans to Q No 3: Two differences between physical measurement and educational measurement are:

- Physical measurement starts from a true zero point; whereas educational measurement does not have a true zero point. Zero in educational measurement is not absolute but relative.
- Physical measurement is direct, definite, and objective; whereas educational measurement is indirect, indefinite, and subjective.

Ans to Q No 4: Two limitations of educational measurement are:

- educational measurement is indirect, indefinite, and subjective; and
- educational measurement is incomplete, since measurement of achievement in any subject is always based on a sample of student behaviour.

Ans to Q No 5: Measurement in education performs various functions, including the main function of estimating change in student behaviour. Measurement in education helps in selection, classification, comparison, prediction, diagnosis, guidance, besides assessing the effectiveness of teaching and learning.



1.11 MODEL QUESTIONS

Short Questions (Answer each question in around 150 words)

Q 1: What do you mean by educational measurement?

Q 2: What are different types of measurement?

Q 3: What do you mean by scales of measurement?

Long Questions. (Answer each question in around 300-500 words)

Q 1: What is measurement? Distinguish between physical and psychological measurement.

Q 2: Discuss the nature of educational measurement.

Q 3: Discuss the functions of Educational Measurement

Q 4: Make a comparison between the different scales of measurement.

*** ***** ***