

ASSESSMENT FOR LEARNING

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M.D.U.

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ASSESSMENT for LEARNING

(MDU)

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PREFACE

Our schools are the living laboratory and workshop for providing education *i.e.* helping the students in their learning. What type of education and development is a ticklish question. A lot of energy and resources are utilized by the concerned agencies for developing and implementing a suitable curriculum for this purpose. The decision, what type of learning experiences are to be given to a learner in a learning situation, however rests on the teacher who is entrusted with the responsibility of looking after the well being of the students. He has to see the readiness and potential of the learner for learning and grasping a thing before setting it as a target for his learning. The awareness about the learners readiness and potential can be fairly possible only after resorting to the process of proper assessment or evaluation of the learner's potential, abilities, interests, attitudes and his entry behaviour regarding the learning of a thing or task. One should thus have a proper knowledge, understanding as well as skills related to assessment for learning. Traditionally we have been emphasizing over the application and use of the mechanism related to assessment of learning. However, assessment for learning is the need of hour as its concept is directly linked with the practices of the philosophy of constructivism and constructivist learning. Moreover there are a number of new trends and practices emerging on the scene of evaluation. A teacher must be well acquainted with these practices and issues related to students evaluation. In this concern, NCTE has provided guide lines to the Universities and Teacher education institutions to modify the existing teacher education programs. As a follow up, M.D. University, Rohtak has introduced a compulsory paper entitled "Assessment for Learning" in its two years B.Ed. program. The present text is specifically designed to meet the requirements of this paper.

For the preparation of this text, the authors has taken help from the writings of many scholars. Their work has been constantly inspired by many of their students and colleagues. The authors feel a deep sense of gratitude to all of them.

What has been presented in the present text may appear a reiteration of what has been effectively said in some already existing publications covering various aspects of this text. However, as happens, every writer has his or her style and way of presentation. The present text, accordingly differs much in many ways with some of its features highlighted as under :

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ASSESSMENT FOR LEARNING

(MDU)

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- • Concept of Assessment, Measurement, Evaluation and Examination
- • Importance and Principles of Assessment
- • Difference among Assessment, Measurement and Evaluation
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- • NCF's 2005 vision of Assessment for Learning
- • Revised Bloom's Taxonomy (2000) for Instructional Objectives :
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- • Assessment Approaches :
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 - Curricular Areas that can't be Tested for Marks

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 - Concept of Test, Measurement and Evaluation
 - How evaluation differs from Measurement?
 - Examination as a tool for Assessment
 - Examination and Evaluation
 - Importance of Assessment or Evaluation
 - Principles of Assessment or Evaluation
 - Assessment of Learning and Assessment for Learning
 - Assessment approaches – Formative and Summative
– Quantitative and Qualitative
 - Teacher as a facilitator in Assessment for Learning
 - Study Questions
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Introduction

The process of teaching and learning in one or the other subjects of the school curriculum always works for the realization of the stipulated teaching-learning objectives by following a well thought programme. Here also a teacher while adopting a definite curriculum and methodology of teaching strives hard for the achievement of the desired aims and objectives of teaching within the specific time period. In his way, meanwhile he naturally becomes eager to know about the results of his striving either for providing necessary magnitude and direction to the ongoing, teaching-learning process or for taking some or the other educational and administrative decisions in the interest of this students. For doing so he however needs some specific information related to the nature of the realization of the set teaching-learning objectives and individual achievements of his students in terms of the

expected behavioural changes. In this task he is more often helped by the data derived through the means like test, measurement, assessment and evaluation. Let us know about these so used terms for providing needed information to the teachers to take necessary educational and administrative decisions.

Concept of Test, Measurement and Evaluation

You may have heard or undergone through the instruments like achievement tests, aptitude tests, intelligence tests etc. Each of these instruments consists of a standard set of questions needed to be answered by you. On the basis of responses given by you, we obtain a measure/score *i.e.* a numerical value of the characteristic possessed by you in relation to your performance in a subject, intelligence or aptitude etc. In this way you can understand a test simply as a measuring instrument consisting of a standard set of questions for being answered by the individual student with regard to one or the other characteristics of his behaviour. Mind that the use of the term 'test' is only limited to the use of some or the other specific set of questions and 'testing' as a process of making the students answer that set of questions. Upto this extent no process or act of measurement is involved. It begins with the work of assigning numbers to the test results according to a specific rule like counting correct answers and assigning one mark each for every correct answer.)

Measurement in this way is a one step ahead of the process of testing. When the work of testing ends, measurement comes into picture for assigning numerical values to the test results. However, the process of measurement does not necessarily rest on tests and testing. It is quite a broader concept. Both testing (like achievement tests and intelligence) may be used in the process of measuring a characteristic, *i.e.*, obtaining information in a quantitative form. We may derive scores or obtain numerical description of the degree to which you as an individual possess a particular characteristic. In this way how much potential you possess in a particular aspect of your behaviour (*i.e.*, knowledge, understanding, skills and applications of mathematical facts and principles etc.) may be adjudged quantitatively with the help of the product and process of measurement. Let us make the meaning of term measurement more clear with the following definitions :

1. *Carter V Good* : Measurement may be understood as "the comparison of a quantity (exhibited in a particular case) with an appropriate scale for the purpose of determining (within the limits of accuracy imposed by the nature of the scale) the numerical value on the scale that corresponds to the quantity to be measured."

—(1959, pp. 337-38)

2. *Remmers, Gage and Rummel* : Measurement refers to observations that can be expressed quantitatively and answers the question "how much."

—(1960, pp. 7-8)

3. *Mahesh Bhargava* : "Measurement is the process of assigning symbols or numerals to observations, objects or events in some meaningful or consistent manner according to rule"

—(1987, p. 53)

4. *Gronlund and Linn* : The term measurement is limited to quantitative description of pupils : that is, the results of measurement are always expressed in numbers (e.g. Mary correctly solves 35 out of the total 40 arithmetic problems). It does not include qualitative descriptions (Mary's work was neat) nor does it imply judgement concerning the worth or value of the obtained results.

—(1990, p. 6)

The analysis of above definitions may clearly reveal that measurement is nothing but a process of quantification, *i.e.*, assigning units of measurements or numeral values to the types of characteristics observed in the behaviour or nature of an individual or object during some observation or testing. For example, when we say that the height of an individual is 160 centimetres or his score on a unit test of mathematics is 8 (correctly answered 8 out of the 10 objectives type questions), we are definitely resorting to the process measurement. A centimetre and score of one both here represent the respective units of measurement and the individuals are assigned different units on the basis of the performance exhibited by them during observation or testing. In fact, we try to assign numeral values or express the results of our observations or testing in a quantitative term through the process of measurement as precisely and objectively as possible.

Now coming to evaluation, we will soon realise that it is a quite comprehensive and broader term than measurement and testing. A glimpse of the following definitions may reveal the meaning and nature of the term evaluation.

1. *Carter V. Good* : Evaluation is the process of ascertaining or judging the value or amount of something by use of a standard of appraisal.

—(1959, p. 209)

2. *Stufflebeam and others* : "Evaluation is the process of delineating, obtaining and providing useful information for Judging decision alternatives."

—(1971, p. 25)

3. *Remmers, Gage and Rummel* : "Evaluation is not just a testing programme. Tests are but one of many different techniques such as observation, checklists, questionnaires, interviews etc. that may contribute to the total evaluation programme."

—(1960, p. 6)

4. *Wrightstone* : "Evaluation is relatively new technical term introduced to designate a more comprehensive concept of measurement that is applied in conventional tests and examination the emphasis is upon broad personality changes and major objectives of educational programme. These include not only subject matter achievements but also attitudes, interests, ideals, ways of thinking, work habits and personal and social adaptability."
—(1956, p. 8)

5. *Torgerson and Adams* : "To evaluate is to ascertain the value of a process or a thing. Thus educational evaluation is the passing of judgement on the degree of worthwhileness of a teaching process or learning experience."
—(1955, p. 5)

6. *Ahmann and Glock* : "Educational evaluation is a process in which a teacher commonly uses information derived from many sources in order to arrive at a value judgement. The information might be obtained by using measuring instruments as well as other techniques, direct observation and interviews. An evaluation may or may not be based upon measurement data, though appropriate measurement results are customarily used if they are available. Thus evaluation includes not only measuring or in some way identifying the degree to which a pupil possesses a trait or the degree of which a pupil's behaviour may have been modified as a result of an educational experience, but also judging the desirability and adequacy of these findings."
—(1959, p. 13)

7. *Indian Education Commission (1966)* : "It is now agreed that evaluation is a continuous process, forms an integral part of the total system of education and is ultimately related to educational objectives. It exercises a great influence on the pupil's educational achievements but also improves it."

8. *Quillen and Hanna* : "Evaluation is the process of gathering and interpreting evidences on change in the behaviour of the students as they progress through school."

An analysis of the above definitions may clearly reveal the following facts about the nature and characteristics of the term evaluation.

- Evaluation is more comprehensive term than measurement or testing.
- It represents a continuous process and overall efforts for knowing about the progress of the learner.
- It provides quantitative as well as qualitative description of the outcomes of teaching-learning process.
- It helps in knowing about the changes in behaviour related to the domains of the learner's behaviour as a result of the process of teaching-learning.

- It provides greater scope and flexibility for the use of variety of means and techniques rather than limiting itself to certain tests or conventional examinations.
- It represents a comprehensive plan of better testing and measurement for inquiring into the quality of the output in the light of the set objectives.
- It provides sufficient value judgement about the progress of the learner, teacher's efforts and effectiveness of the instructional programmes.

How Evaluation Differs from Measurement ?

From the description given above we can easily conclude that evaluation is quite a wider and more comprehensive term than measurement. The differences between them particularly in the field of teaching and learning can be further emphasized as below :

1. The term measurement is limited to the quantitative descriptions of the potential and achievements of pupils. *i.e.*, the results of measurement are always expressed in numbers (e.g., Ramesh's score on an achievement test is 60 out of the total 100 marks). Here no qualitative descriptions like neatness of his work, originality in the solution of the problems etc. are mentioned. Evaluation, on the other hand, may include both quantitative descriptions (measurement) and qualitative description (non-measurement) of the pupils. Therefore, the changes in behaviour of the pupils that can be expressed in quantitative terms may only be ascertained through measuring devices. But where expression of the outcomes is available in the qualitative terms, measurement fails to convey the results. It is why the changes in the areas like interests, attitudes, habits, temperament, personal and social adjustment etc. cannot be measured as absolutely as may happen in the measurement of the acquisition of skill and information, related to the conative and cognitive domains of the learners's behaviour. The changes in the affective domain (assessed through non-measuring techniques) can thus be made a subject of evaluation and not of the measurement. In this way, if we need a comprehensive evaluation of the growth and development of the pupils in all the dimensions and domains of their personality and behaviour we have to go beyond the use of measurement and adopt evaluation techniques.
2. However the most important and essential feature and distinction between the two terms evaluation and measurement lies with regard to the inclusion and non-inclusion of value judgements in the functioning. Measurement while limited to the quantitative description

of the attributes of the pupils never tries to pass value attributes judgements over the measured attributes like good, bad, satisfactory, unsatisfactory etc. For example, it may declare that Sheela has got 60% marks in a mathematics test but it will not pass any value judgement over the worth or value of her getting so much marks. In this way where measurement is limited to provide answer to the question how much is the achievement of a pupil, evaluation goes a step further to pass value judgement over the quantitative expressions derived through measurement. While evaluating, thus a teacher will definitely pass value judgement over the quantity expressed as 60%. He will provide division or grading and will consider her achievement as satisfactory, unsatisfactory, desirable or undesirable according to the individuality and needs of the teaching-learning situations.

3. In the process of evaluation value judgements are passed over the desirability of the results irrespective of their nature (being derived through measurement or non-measurement techniques.) Hence while resorting to evaluation teacher may pass value judgement over getting 60% marks in an achievement test (involving measurement techniques) or interpret the results of a simple observation, interview encounter and rating scale grading for considering the value or goodness of the performance exhibited by a individual student. It is implied therefore that where measurement automatically falls into the domain of evaluation, it is not at all essential for the product and process of evaluation to depend upon the mercy of any quantification or measurement of the attributes of a pupil for passing judgement, over the worthwhileness of his progress and potentiality during a teaching-learning process, *i.e.*, bringing modification in his behaviour through any piece of formal or informal instruction.
4. Summing in this way we may easily conclude about the comprehensiveness and wideness of the term evaluation over measurement in the following ways :
 - (i) Evaluation may depend upon the results of measurement but goes a step further for passing judgement over the measured results, *i.e.*, interpretation and worthwhileness of 60% marks according to the given circumstances.
 - (ii) Evaluation may depend upon the results of non-measurement or testing device like observation, rating and interviews etc. for passing out the judgement of their worthwhileness in a given situation.
 - (iii) Evaluation may include both quantitative description (measurement) and qualitative descriptions (non-measurement) of pupils for passing value judgement over the worthwhileness of their progress.

The above cited comprehensive nature of evaluation in relation to the involvement of measurement techniques (quantitative descriptions) and non-measurement techniques (qualitative descriptions) may be properly depicted through the following relationships.

- (i) Evaluation = Quantitative descriptions of the progress (measurement) + value judgement.
- (ii) Evaluation = Qualitative descriptions of the progress (non-measurement) + value judgement
- (iii) Evaluation = Quantitative + Qualitative descriptions of the progress (measurement and non-measurement) + value judgement.

All the above three relationships may be further illustrated through a single flow diagram depicted as under.

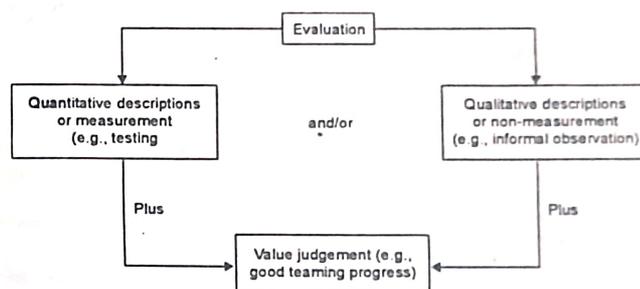


Figure 1.1. Comprehensive Nature of Evaluation
(Source : Gronlund and Linn, 1990, p. 6)

Examination as a tool for Assessment

Every one of us is very much acquainted with the use and application of the term examination. As a student you must have gone through a number of examinations while getting promoted from one grade to another or seeking admission to academic classes and professional courses by crossing the barriers of entrance examinations. In a course of a year while studying in a particular grade, you may have faced a compulsion of appearing in the terminal, half yearly or annual examination for enabling you to be declared as passed in that grade. In fact what we term as examination is an age old concept used for measuring the achievement or performance level of the students well after a specified time measuring the achievement or performance areas determined by the curriculum or syllabus of a particular grade or school stage (*i.e.* elementary, Secondary or higher secondary). The

term examination has been under attack on one or the other accounts and have now been almost replaced by the term evaluation.

Examination and Evaluation

In practice many times these two terms are used interchangeably. But in spite of the fact that both aim at the same thing or things, they differ in so many ways. Evaluation is relatively a new term in the field of education. It has a more extensive scope and is definitely more valid, objective and purposeful than examination. The relative difference can be summarized as under:

Examination	Evaluation
1. It refers to a system where students are tested just at the end of a definite period of instruction.	1. The changes brought in the behaviour of the students through education are continuous. Evaluation helps in the continuous appraisal of such changes.
2. It limits itself to the testing of knowledge and skills of subject matter.	2. Through evaluation it is possible to test the overall changes brought in the behaviour and personality of the children.

Concept of Assessment

We use the term assessment in various ways in our day-to-day life such as assessment of the rental value of a building, assessment of the property tax on a house, internal assessment of the achievements and performances of the students, quality assessment of a thing or person etc. In saying so, we often mean to have a proper value judgement or worth of a thing, person or process. The quantitative as well as qualitative aspects of its worth are very much involved in doing assessment of a thing or process. Decidedly in this way the term assessment is more comprehensive than the term measurement. While having assessment of a house we have to take consideration the number of rooms, quality of the material used in its construction, the type of flooring and roofing its furnishing and type of facilities available in the form of electricity, ventilations, modular kitchen, toilets and bath room, hall and garden etc. Here thus we would like to use quantifying terms as well as qualifying terms while providing assessment report of this house. The same will also happen when we would be asked to provide the assessment report of a students or self-assessment report of our own as teacher/employer of the school. While preparing assessment reports

of the hockey team in our charge we have to assess the work of each player of the team in quantitative as well as qualitative terms e.g. average time devoted in practice, attendance in the field, number of penalties committed in the practice and competition matches, the goals scored or allowed, etc.

In the field of education the term assessment in reference to the searching or judging of the achievements or performances of the students is very much utilized as to take a wholesome consideration about the value or worth of a particular student by making use of quantitative and qualitative description of their achievement and performances regarding a particular course of learning during a specified time.

In case we try to compare the use of the terms assessment and evaluation in reference to the screening or passing value judgement over the work or quality of the performances shown by the students in a particular learning field we may come to realize that both aim and mean for the same. It is why the term assessment and evaluation are used interchangeably much like as the synonyms terms.

Importance of Assessment or Evaluation

The assessment or evaluation of the learning outcomes of the students at various stages or aspects of the teaching-learning process prove quite valuable for all the stake holders who are associated with the tasks and applications of the results of evaluation/assessment in one or the other ways. The importance and value of assessment or evaluation can be properly discussed in two separate heads by taking into consideration the things and aspects like below.

- A. Exercising overall control over the teaching-learning process
- B. Helping in executing a number of functions or purposes

Let us discuss these aspects one by one for understanding the value and importance of the assessment or evaluation of the learning outcomes of the students in a teaching-learning situation.

A. Exercising overall control over the teaching-learning process

All teaching is directed towards the welfare of the students and the welfare of the students lies in bringing desirable changes in their behaviour for their adequate progress and development. At a particular stage and teaching-learning situation, therefore, proper planning is made for bringing desirable changes in the behaviour of students. The task begins with the setting of proper teaching-learning objectives i.e. the type of changes in behaviour of the pupils expected as a result of the ongoing teaching-learning process. How these expected changes in the behaviour of the students may be introduced or the stipulated teaching-learning objectives may be realized,

thus becomes a 'focal point' for the further planning and organisation of teaching-learning activities. As a result suitable learning experiences in the form of subject matter and other practical activities are planned and organised with the help of proper teaching-learning methods, strategies, aids and devices. Teacher and students both thus strive hard for the realization of the teaching-learning objectives by taking proper help from the organised learning experiences (subject matter and curriculum) and methodology and strategy of teaching-learning. Meanwhile there comes a stage when teachers and students both desire to know the outcomes of their teaching and learning efforts. To what extent the stipulated teaching-learning objectives have been realized or are in the proper process at their realization is a basic question that needs to be answered from time to time during the overall period of a teaching-learning session. This can be only answered properly by an appropriate scheme of evaluation. In this way where setting of objectives starts the process of a teaching-learning act the selection and organisation of the learning experiences supported by the proper selection and employment of teaching-learning methods and strategies pushes it forward for the proper realization of the set objectives. Evaluation in between provides the ways and means of exercising control over the total teaching-learning objectives, learning experiences ; methods and technique and efforts of the teacher and students and in this way may be properly referred to as controlling key of the over all teaching-learning process. Its role as a controlling key may be well assumed through the following diagram.

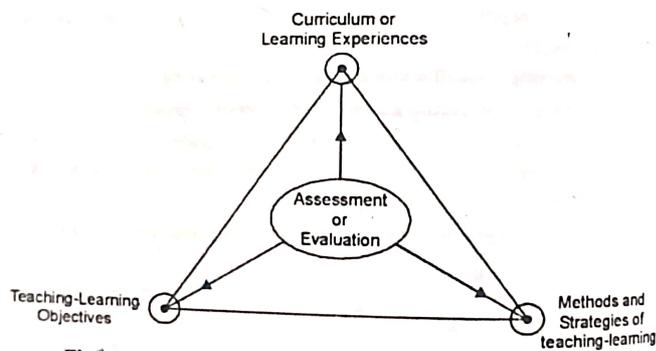


Figure 1.2. Controlling over the teaching-learning process.

B. Functions and purposes served through Assessment or Evaluation
Assessment or evaluation of the learning outcomes of the students may be found to help in serving or realizing the following important functions.

1. Motivational Functions : The knowledge of the results and progress is a quite strong factor for motivating an individual to continue his efforts in the right direction. The assessment measures help in acquainting the learners as well as teachers about the outcomes of their efforts and this in turn may prove a good incentive for keeping them on the teaching-learning "track". In addition to this, assessment data is quite often used for providing proper incentive to the students as well as teachers in the form of appreciation, grades, stickers, comments, division, certificate etc. Such incentives play a dual role firstly to motivate the individual who receives such incentives and secondly to other who take it a challenge for working effectively to get such incentives.

2. Decision Making Functions : Assessment or Evaluation data may prove quite useful for taking important decisions with regard to the welfare of the students and the society as well as improving the processes and products of education.

- Assessment data help in making decision for the selection of students to various courses and areas of study.
- It helps in taking decision regarding promotion or retention of the students, assigning grades, merit position, certification and awarding of degrees and diplomas etc.
- It helps in taking valuable curricular decisions like to continue or discontinue a scheme of studies, methods of instruction, introduce changes in the instructional objectives or methods of evaluation etc.
- It helps in taking decision regarding the type and amount of guidance children need and how can it be properly imparted.
- It may help in deciding the need of special or remedial education to the children and the ways and means of providing such education.
- It may help in taking valuable and serious administrative decision like rewarding or punishing the child, maintain or dismiss a teacher or other professional connected with the instructional work of the school.

3. Informational or Feedback functions : Evaluation data may be successfully used for providing useful information or feedback to the concerned personnel in order to maintain the essential communicational channel in the process of teaching-learning like below :

- (i) It may provide a good feedback to the students by constantly informing them about their progress (strengths and weaknesses) and level of performance concerning their learning efforts.

- (ii) It may also provide sufficient feedback to the teachers in terms of the functionality and effectiveness of their models and strategies of teaching.
- (iii) The outcomes of the valuation in the form of test scores, grades, stars, certificates, report cards, comments and remarks of the teachers provide **unique information to the parents** about the progress of their children. Such information is quite valuable for the welfare of the child firstly because he may get desired help and assistance from his parents for his educational progress and developmental needs and secondly for reinforcing his learning behaviour and keep him motivating outside the boundary walls of the school.
- (iv) Evaluation data may also provide **necessary information to the school personnel** other than the teachers connected with the evaluation task. They can know much about the learning potential, abilities and capacities, interests and attitudes of a child concerning the different learning areas and in turn may help the child in his proper growth and development.
- (v) Evaluation data provide information to the school administrators and educational authorities about the progress and functioning of the teaching-learning activities. Based on such communication, they may be able to exercise proper control over the working of the school in their charge.
- (vi) Evaluation data may provide valuable information about the working and functioning of a school to the general public. Many a time, school's reputation is associated with the shining of its students in public or state examinations and competitions.
- (vii) Evaluation results may also help in fixing responsibilities and accountability for the poor performance of the students with regards to their needed development in a particular area or subject.
- ✓ **Certification, Grading and Promotion functions** : Evaluation or assessment data may be properly used for serving the functions like below.
- (i) For providing certificates to the students certifying that a particular student has passed a learning course, standard or school/public examination by mentioning its scores, quality of performance and place in the class, district or state.
- (ii) It may help in Grading (like A+, A, B, etc.) of the students for telling his or her standing with regard to his performance or achievement in the scholastic or non-scholastic areas.

- (iii) It may help in promoting a student in the next senior class, level or standard of his learning/education. It may also help the teachers and school administrators in choosing the captain of a team, monitor of a class and leading boy or girl in cultural and social activities.

✓ **Diagnostic Functions** : Evaluation or assessment data may also help in the diagnosis of learning difficulties of the students in various scholastic and non-scholastic areas. Based on such diagnosis then suitable steps can be taken for

- (i) the organization of guidance and counselling programs to the needy students.
- (ii) the organization of special or remedial education to the needy children in relation to their learning difficulties.

✓ **Planning Functions** : Assessment or evaluation data may also be properly used for exercising the following functions related with the planning of the teaching-learning tasks.

- It may help in the formulation of the set objectives for carrying out the teaching-learning tasks.
- It may help in the selection and organisation or appropriate learning experiences, framing syllabus and developing curriculum.
- The methods and strategies of teaching-learning, the aid material used etc. can be properly planned in view of the evaluation outcomes.
- Remedial teaching, individual teaching and group activities, special educational programmes can be better planned in the light of the evaluation outcomes.

Principles of Assessment or Evaluation

The process and task of assessment and evaluation in the field of education needs to be governed through some basic principles outlined as below :

1. Principle of knowing what is to be measured and evaluated.
While resorting to assessment or evaluation one should be quite clear and definite about what is to be assessed or evaluated by him. Unless one does not know that he is to measure the length, breadth and height of a room, how can he proceed with his task of measuring the dimension of a room. Same is true with the measurement and evaluation in the field of education. One should know exactly to what extent he has to measure or evaluate the performance of the group of children in a particular subject or work area? What are the topics or content axes to be covered through his evaluation measure, should be known by a teacher who is going to construct an

achievement or unit test for measuring the learning outcomes of his students? What type of behavioural changes—cognitive, conative and affective one has to evaluate a measure through his evaluation tools, should be well known for an evaluator for getting desired success in his task.

2. Principle of selecting appropriate tools of measurement and evaluation. Much depends upon the quality and purposes served by the tools employed in the task of measurement and evaluation. An evaluation, therefore, should be quite cautious and selective for the selection of a proper tool or combination of tools for serving his purpose. The measurement and evaluation of the outcomes related to cognitive, conative and affective domains differs a lot with each other. Hence different measuring and evaluation devices need to be employed for the needed evaluation and measurement of the performance related to these behavioural domains. Similarly different purposes are served through oral, written and practical modes of evaluation and even in the written mode essay type, short answer type and objective type question emphasize more on measuring or evaluating one aspect of the achievement or performance than the other. In this way, sufficient care should always be taken for the selection and use of appropriate measuring or evaluation device.

3. Principle of continuity. The effectiveness of any scheme of measurement and evaluation of the students' performance lies in its continuity. Since, the process of teaching and learning needs a system of continuous evaluation for its proper control, management, feedback and improvement, it becomes quite imperative that we must try to maintain a system of tests and examination that may provide us a proper continuity in the evaluation and measurement the performance and achievements of the students.

4. Principle of totality and comprehensiveness. The evaluation and measurement of the achievement and performance need to be carried out in totality and comprehensiveness. Our goal is to seek an all-round harmonious growth and development of the capacities and potential of the students. How far we have been successful in our objectives can be better realized if we adopt a system of measurement and evaluation that can provide us a total and comprehensive assessment of the student's progress in this direction. For this purpose if need arises, we must not hesitate to make use of a combination of the measurement and evaluative measures e.g. employment of oral, written and practical modes of measurement and evaluation, combination of essay, short answer type and objective type of questions in a unit terminal or sessional test, giving place to observation, rating scale, interview and personality assessment techniques in addition to

the conventional mode of evaluation, pooling of the rating or other evaluation results of different evaluators etc.

5. Principle of considering measurement and evaluation as a means rather than end. Whatever measurement or evaluation devices we employ for the assessment of the performance achievements of our students, these should always serve the means of the assessment or evaluation of the teaching-learning outcomes. In any case, these should not be allowed to become an end in themselves. The student should not work to get success, grades or division by being subjected to these measures and in this way the measures of measurement and evaluation should not be allowed to play the dominant role as the master instead of playing the role of a service provider for realizing the ends of a teaching-learning process.

6. Principle of bringing modification and improvement. The process and task of evaluation can not be static and rigid. It needs improvement and modification in case it is diagnosed with bottlenecks and shortcomings or falling short of the expectations in serving its purposes. There must be objectivity, reliability, validity, diagnosticity, comprehensiveness and practicability in a system adopted for the measurement and evaluation of the learners' outcomes. In case, it does not meet the required criteria of an ideal evaluation, it should be modified, changed or replaced by some or the other better measures. Many times, we can get feedback from the evaluation experts learners, teachers and the other users of the results of the adopted system of measure and evaluation for bringing the needed improvement in it. We should try to hear the timely call given to bring the needed changes and reforms in our adopted system of evaluation and measurement.

Assessment of Learning and Assessment for Learning

Assessment of Learning

The term assessment of Learning : Stands for a type of assessment task carried out for assessing the learning or behavioural outcomes of the learners after the execution of a learning activity, schedule or program. The main characteristics of such type of assessment, may be outlined as below :

1. Through such type of assessment, we try to assess :
 - (i) how good or bad a learning has been shaped or occurred as a result of the giving learning efforts ?
 - (ii) how far the learning objectives set for a particular piece of learning have been achieved ?
 - (iii) What type of changes or modification in the behaviour of the learners are visible as a result of learning ?

2. It stands for the net result or outcomes of a learning process accessible through a net difference between learning output of the terminal behaviour and initial input of an entry behaviour, *i.e.*, Assessment of learning = Learning potential at the end of a learning process
- Learning potential as the beginning of the learning process
3. It is carried out strictly at the end of a learning to get acquainted the learners with the fruits of their learning efforts.
4. It can take the shape of a formative or summative assessment depending upon the time and schedule adopted for assessing the learning outcomes of the learners. When it is undertaken well after the finishing of a course, semester or otherwise after a fixed duration then it can take the form of a summative assessment. However, when the process of assessment or evaluation is turned into a continuous process of assessing the learning outcomes of the students, then it results with a type of assessment known as formative assessment.

Here we try to have assessment of the learning outcomes of a learner quite frequently, time to time for having a full check and control over the learning process and output of a learner.

Assessment for Learning

The term assessment for learning stands for a type of assessment task carried out for accessing the existing potential of a student or learner to ascertain how far he is capable of learning a given task. The output of such assessment makes the task of a learner or teacher to learn or teach a particular piece of learning quite easy and methodological. Based upon this input he may plan for his journey of learning or teaching in a proper form. The nature of this type of assessment is characterized with the features like below :

1. It is carried out well before undertaking or executing a task of learning.
2. The decision about undertaking a learning task is carried out in the light of the results derived from such type of assessment.
3. A teacher tries to resort to such type of assessment in the form of testing the previous knowledge of his students regarding the teaching, learning of a particular topic well before the presentation of the subject matter related to that topic to the class. He plans his methodology and delivery of the lesson by getting insight from the result of the previous knowledge testing, *i.e.*, a typical form of assessment for learning.
4. The feedback received through the tests and measures like IQ and EQ testing, aptitude test, interest inventory, personality inventory,

temperament and moods recognition may work as an effective input in the form of assessment for learning. What type of learning is suitable for a particular type of learners, may be properly undertaken in the light of the feedback received through such assessment. The decision about the methodology employed, devices and aid material used etc is also undertaken for carrying out learning process in the light of such feedback.

5. What we know as a diagnostic assessment or testing can be very well termed as assessment for learning. Through such assessment or testing we try to diagnose or identify the learning difficulties, strength and weaknesses of a learner in relation to the learning of a particular task topic or subject area. The feedback received from such diagnosis, then can help in planning for and undertaking a learning task remedial in nature for helping the learner in getting rid of his learning difficulties. Removal of such hurdles in the path of learning may facilitate the task of further learning and in this way diagnostic testing or assessment can successfully assume the role of assessment for learning.
6. In formative assessment we try to assess the learning of a learner time to time to test or assess his progress on the learning path. Such assessment at one or the other stage of a learning process may play well the role of assessment for learning since it acquaints the learner with his readiness or potential for further learning with sufficient knowledge of any deficiency, short coming or difficulties in his path of learning. Such feedback may help the learner in planning and organising the task of further learning in a desirable way.

In this way assessment for learning may be carried out in a variety of mode by adopting one or the other means. However, in all its form and shapes its nature and purpose always remains totally formative, *i.e.*, helping or preparing a learner for undertaking one or the other learning task for its execution in a proper way.

Assessment Approaches

Assessment for Learning and assessment of learning as emphasized above involve the use of two types of approaches - Formative as well as Summative. Moreover, there are scholastic as well as non-scholastic areas of curriculum for which we need quantitative and qualitative assessment. In this way approaches towards assessment may be divided (A) Formative and Summative assessment and (B) Quantitative and qualitative assessment.

Let us discuss these approaches one by one.

A. Formative and Summative Assessment or Evaluation

Formative Assessment or Evaluation : This type of assessment is conducted well during the teaching learning process. When a teacher has taught some content or some unit or provided some learning experience, he has a need to determine the outcome. Similarly, students also need to know about their progress in the path of learning. The formative evaluation helps in this task by providing useful information to both teacher and students about the strengths and weaknesses of their teaching and learning. In the light of this information, they may plan and engage for the mid course corrections in pace or content and methodology of instruction. The formative evaluation may be carried out both in formal (like checklists, quizzes, question-answers, assignments and tests) as well as informal (like observations, listening to students comments and conversations) way. The essential characteristics of such assessment may be briefly summarized as under.

(i) Formative Assessment

- It is administered during the lesson taught or instruction imparted.
- It helps in informing the students about their progress chiefly about the amount they have yet to learn before achieving the set objectives.
- It is useful to the extent it remains informative, closely related to the things being taught, timely and frequent.
- It helps the teacher by providing him qualitative and quantitative data for bringing necessary modification in his teaching.
- It proves very useful in guiding the students, planning remedial instruction and prompting them to ask for necessary help.
- It should in no way be used by the teacher and the students, just as for making comparison among the students or making a certifying judgement. The results of such assessment should not necessarily appear in any official record.

(ii) Summative Assessment : Such type of assessment is carried out at the end of a piece of instruction lesson or unit. Actually it represents a final test or measure of the student's progress or gains made by him as a result of a course of learning. Both formal as well as informal techniques may be used for conducting such evaluation. The formal techniques may include tests-standardized as well as teacher made, questionnaires, interviews, rating scale, work assignments, projects etc. In the informal techniques, we may include observations, discussions, comments and feedback given by the students etc. Such type of assessment is chiefly characterized as following.

- It summarizes the final progress of the students as a result of a course of learning unit or lesson.
- It is carried out less frequently than formative assessment, usually at the end of a unit or course of instruction.
- The results of such evaluation may be safely used for making comparison among students, placing them in order of merit or taking decisions about their promotion and awarding degree or diploma. It is this characteristic of summative evaluation which enables it to be called as certifying evaluation.

B. Qualitative and Quantitative Assessment

As we know assessment is helpful in collecting information regarding the level of one's performance, achievement or potential in a learning area or in relation to the possession of some traits or attributes of one's personality. This collected information or data may differ in its nature. It may be both quantitative as well qualitative and that is why the assessments responsible for deriving quantitative and qualitative information/data are named as quantitative assessment and qualitative assessment. The nature of the information received through the process of assessment may thus work as a good criteria for classifying the assessment as quantitative and qualitative assessments. Let us know about these forms of assessments.

Quantitative Assessment

In quantitative assessment we collect information or data about the learning outcomes or performances of the learners in their quantitative form. The measurement and assessment of the learning outcomes of the students in their cognitive and psychomotor behavioural domains usually results in deriving quantitative data.

In the affective behavioural domains of the learning outcomes also the results derived through the use of psychological tests like intelligence tests aptitude tests, attitude scales, personality inventory, adjustment inventory may provide quantitative information in the form of numerical scores for the interpretation of the quality and nature of one's intelligence, aptitude, attitude, personality traits, adjustment etc. helping intra individual or inter-individual comparisons.

In making use of various tests and assessment tools for the measurement/assessment of the scholastic performances in various curricular areas, we most often come out with quantitative information expressed in the form of scores, or numerical marking. Similarly when we measure performance of the students in psychomotor domain, the quality and nature of the development and applications of one or the other psychomotor skills

in sports, physical education, arts and painting, work experiences and crafts, laboratory and practical work in sciences including home science and come out with the related quantitative information or data (such as one has jumped to that height, competent enough to lift that amount of weight in one or the other category of weight lifting championship etc.) We are resorting to a type of assessment known as quantitative assessment.

In this way whatever the behavioural domains may be, when we come out with quantitative information or data with the measurement or assessment of the learning outcomes or performances of the learners, the type of assessment involved always is quantitative assessment. In such assessment the results are usually expressed in terms of numerical scores or marks. The common benefits derived through such marking or numerical scores may be outlined as below:

1. Marks or scores obtained in an achievement tests or evaluation measure may help in seeking inter-individual or intra-individual comparisons (*i.e.* such as comparing the scores/marks obtained by Ramesh in the subject mathematics with the scores obtained in English or other school subjects or comparing his scores with the scores of other students of the class or the whole lot of examinees appearing in the test). For this comparison, we usually try to compute percentages *i.e.* converting raw scores or marks obtained by the students in their percentage scores/marks. The measure of central tendencies like mean, median, mode may also be computed for interpreting one's scores or marks as average, above average or below average in relation to the performance of others in the group. The computation of percentiles and percentile norms is also properly possible with the help of raw scores of the students. It can help in telling the relative position of an examinee in the whole group of the examinees *i.e.* the percentages of the examinees getting less marks than his own marks.
2. Marks or scores when converted into percentages may help in taking useful decisions like declaring the students, pass, fail, reappear, and provide divisions like I, II and III or assigning merit position and distinctions etc.
3. Marks obtained and percentages computed may also help in converting and expressing the performance of the students into certain distinctive grades and categories declaring them as excellent, very good, good, poor and discouraging in relation to their achievement or performance in one or the other learning or performance areas.

Qualitative Assessment

Qualitative assessment calls for the collection of data or information about the learning outcomes or performance of the students in qualitative form. The assessment and evaluation of the learning outcomes of the learners in attentive behavioural domain most of the time involves the measures involving qualitative assessment. Moreover, the use of non-testing devices such as observation, interview, performance based assessment may primarily provide qualitative data. Here we can't make use of grades, marks or numerical scores for expressing the outcome of our assessment as we happen to use in the case of quantitative assessment (*i.e.* the results of the testing devices). The qualitative description is a necessary part of conveying the results of a qualitative assessment, and such qualitative description can't be possible through the use of quantitative expression (numerical scores or marks etc.) derived through quantitative assessment.

Let us take for example the quality of one's product or sessional work. In its evaluating and expressing the evaluation outcomes when we make use of marks or grading then the proper purpose of providing sufficient feedback to the students about the quality of their efforts and performances is not served in an appropriate and adequate manner. The necessary strengths and shortcomings of their efforts and performances can only be properly revealed if the results of their evaluation are conveyed to them through the necessary qualitative descriptions. Similar is the case with behavioural assessment. How far one has been able to bring needed changes in his behaviour, what is lacking or seems to be appreciable and encouraging in one's behaviour can only be properly revealed to him through the qualitative description of the good and poor things observed or diagnosed in his behaviour through the help of evaluation devices. How one can improve his handwriting, oral communication, skills related to one or the other areas of knowledge and application, social and emotional behaviour, bring suitable modification in his attitudes, habits, ways of thinking and doing the things may be well supported through the detailed and analytic feedback provided by the qualitative description of the evaluation outcomes of one's behaviour, created and constructed products or expressed views (orally or written) on a subject.

In this way when we talk about formative assessment, standard based assessment or criterion referenced evaluation, or promotion of creativity, and constructiveness on the part of the learners or getting necessary, motivation, encouragement including the necessary ideas about one's learning difficulties and shortcomings, then the suitable and appropriate means and mode of expression in the qualitative descriptions and the data

for conveying such qualitative description can only be made possible through the use of measures and devices yielding qualitative assessment in place of the quantitative assessment.

Teacher as a facilitator in Assessment for Learning

Assessment for learning involves a type of assessment that is formative in nature in contrast to assessment of learning which is predominantly summative in nature. The results of such assessment provide information or data about the strengths and weaknesses of a learner in relation to the learning a particular task, topic or subject area and this feedback then may pave the way of planning needed teaching-learning or instructional work in a classroom situation.

The question may arise what type of role should a teacher play in arranging and organizing the type of tasks or activities involving assessment for learning. As a variety of the various roles position, a teacher may be found to act as the transmitter of knowledge, a model or a facilitator depending upon the need of the teaching-learning situations or his own styles and attributes of teaching.

As far as a teacher's role as facilitator of the teaching-learning process is concerned. Here he is found neither to demonstrate his ability and strength by playing the role of knowledge transmitter or imposes his personality, behaviour and actions as a model for the keen observation and imitation on the part of his students. From a dominating position now he switches over his role to a well wisher, facilitator and helper always standing by his students for arranging what is needed by them in their tasks of learning and development. The students themselves have to learn and make efforts from their side. No direct instruction or demonstration is available from the teacher's side. However, the path of their learning or imbibing desirable behaviours get smoothened and facilitated with the total commitment of the teacher for the learning and development of his students. As a facilitator he has to help them in setting their learning goals, arranging better teaching-learning situations, selecting appropriate learning styles, using appropriate devices, aids and equipments much in tune with their own capacities, and potential for learning and striving. He is there to guide their path and assist them in their learning. In no case he takes the driver seat and own the whole responsibility of making them to learn what he thinks better for them as happens in the case of his playing the roles of knowledge transmitter and role model.

Actually there is a total paradigm shift in the scene where teacher is supposed to play the role of a facilitator instead of transmitting the knowledge or personalizing his figure as a model. Here cognitivism and constructivism

emerge on the teaching-learning scene in place of the traditional behaviouristic perspective. The child centred approach takes the front seat learning behind the teacher and subject centred approaches. The responsibility of learning is to be owned by the learner himself. He has to know, discover and construct the knowledge he needs or aims at with his own efforts. However, in doing so he may need timely assistance, guidance and help from the teacher. He wants the needed facilities, aids and equipments and necessary enlightenment for his learning path and it is here the teacher may come to his help in his knowledge constructional task in the capacity of a facilitator, guide and helper. The role of the facilitator played by the teacher thus may result in guided discovery as proposed by Jerome Bruner in his guided discovery approach and scaffolding as suggested by Lev Vygotsky in his social constructionist learning.

With all what has been said above, we have just tried to portrait a picture of what is expected from a teacher in his role of a facilitator in providing instruction or arranging teaching-learning experiences for his students. The next question arises, how he should help the students in carrying out the task of formative assessment (assessment for learning) by playing the role of a facilitator so that they may get timely proper feedback about their learning potential, progress, strengths and weaknesses in relation to their further learning. The things like below may prove beneficial on this account.

1. Encouraging and facilitating the mode of self-assessment

Self-assessment in its word meaning stands for a type of assessment of the self that is made by student or learner quite independently at his own. In this way, here the learner takes recognition of the worth, ability, capacity, potential, learning outcomes and performance of his own by judging, evaluating and assessing it in his own ways. A teacher while playing the role of a facilitator should try to encourage and smoothen the task of self-assessment being performed on the part of the students in the manner as illustrated below.

- (i) Students while getting training or coaching some useful skills and tricks in playing a game may be encouraged and facilitated for the assessment of their learning from time to time by getting engaged in the practice and rehearsal exercises. Through their own experiences during this practice and rehearsal or real encounter in sports events or match they may themselves realize, experience or judge the impact of training or coaching on their performance.
- (ii) Students while learning to solve problems of a particular nature in the school subjects like economics, chemistry, physics, mathematics,

statistics may be encouraged and facilitated to undergo in the task of self-assessment by assigning them similar problems (through textbooks, question banks etc.). They may then score their performances with the help of answers available in the texts or question bank appendix.

- (iii) Students may be provided the facilities of looking at the model performances (in its processing and output) in the various activities related to demonstration of performances, productive and laboratory work in fine arts, music, dance and sciences including home science. They may then easily have self-evaluation of their work, products and learning outcomes by comparing their efforts with the models available to them.
- (iv) The students may be encouraged to have audio-video recording or instrument checking of their performances and to have assessment of their performances by comparing it with their own previous performances as well as model performances required on their parts. Likewise a pacer may check his or her progress with the help of a stop watch or timer, or a student may rehearsal and get acquainted with his progress in language skills by the facilities available in the language laboratory. The teacher should try to help the students in getting such opportunities and facilities for their self-evaluation.

2. Encouraging and facilitating the mode of peer assessment

It is a quite known fact that the information regarding, the ability, capacity, interest, performance of an individual can be properly given by the individuals who are quite near to him or to whom he is more accessible or approachable. In the school situations, the peers or classmates are found quite close to each other. They understand each other's potential and way of expression. Therefore in case the peers are provided opportunity to assess or evaluate their own counterparts then they can prove a quite good source or mode of assessing or evaluating each other's potential or learning. A teacher while playing the role of a facilitator, should therefore try to encourage, strengthen and facilitate this useful mode of assessment by paying attention to the things like below.

- (i) More knowledgeable and bright students of the class may be asked to supervise and guide the work of less knowledgeable and the students who are lagging behind in a subject or skill area. They can very well diagnose the learning difficulties of their peers in the performance of a task or learning of something and then assist them to come out with encouraging results.

- (ii) For the assessment of the learning and behavioural performance at the hands of the peers, the tools and techniques like questionnaire and rating scale may prove quite beneficial. While playing the role of a facilitator teacher. A questionnaire containing items helpful in the assessment of the learning, performance and behavioural outcomes of the peers may be given to the students of the class by the class teacher. The analysis of the responses may then provide needed information related to the assessment of the students of the class. They may also be asked by the teacher to rate the performance or learning of their peers.
- (iii) In addition, the teacher should also encourage and facilitate the use of sociometric techniques in the classroom group situation for the needed assessment of the social and group behaviour of the students. The use of a variety of sociometric techniques like sociogram and social distance scales may prove quite beneficial in getting acquainted with the social nature, qualities, interaction and behaviour of the students of a group or class. In this techniques, assessment task is carried out by the peers. They try to judge, rate and provide their opinion about each other.
- (iv) Efforts should also be made by the teacher to make the assessment of the group work and cooperative as well as collaborating learning a cooperative and collective enterprise. While working in a group, the group members should take a collective responsibility of assessing the progress of the group work or cooperative learning under the able leadership of their group leader. The teacher should provide all the needed guidance and assistance for doing so as a part of their role as facilitator for carrying out the formative assessment of the group and individual performance of the students.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. Throw light on the concepts of tests, measurement and evaluation.
2. What is evaluation? How does it differ from the term measurement?
3. Throw light on the concept of examination and distinguish it from evaluation.
4. Discuss the concept of assessment and distinguish between the term assessment of learning and assessment for learning.

5. What is assessment? Discuss its importance and principles involved in carrying out assessment of the performances of the learners.
6. Throw light on the following types of purposes or functions served through assessment or evaluation.
 - (a) Motivational functions (b) Decision making functions
 - (c) Informational or feedback functions (d) Certification, grading and promotion functions (e) Diagnostic functions and (f) Planning functions.
7. What is assessment? Discuss the following types of assessment approaches.
 - (a) Formative and Summative (b) Quantitative and Qualitative.
8. Discuss the role of teacher as a facilitator in assessment for learning.

B. SHORT ANSWER TYPE QUESTIONS

1. What are tests/examinations?
2. What do you mean by the term measurement/evaluation/assessment?
3. Distinguish between assessment of learning and assessment for learning.
4. Name the various principles of assessment.
5. What is certification, grading and promotion functions of assessment?
6. How does assessment help in decision making related to educational matter?
7. What is formative/summative/quantitative/qualitative assessment?
8. Distinguish between formative and summative/quantitative and qualitative assessment.
9. Tell two things regarding the role of teacher as a facilitator in assessment for learning.

NCF 2005's Vision of Assessment for Learning

Chapter Outline

- Introduction
- Examination Reforms – Need and Essentials
- Assessment and Evaluation
 - The purpose of Assessment
 - Assessing Learners
 - Assessment in the course of teaching
 - Curricular areas that can't be tested for marks
 - Design and conduct of assessment
 - Self-assessment and feedback
 - Areas that require fresh thinking
 - Assessment at different stages
- Study Questions

Introduction

National Curriculum Framework (NCF)-2005 is a valuable educational document developed by NCERT for providing guidelines for developing school curriculum or syllabai of different states in tune with the emerging needs of our developing country. It draws its perspectives and visions from a number of national documents and proceedings like National Policy on Education (NPE, 1986), The Program of Action (POA, 1992), Focus group discussion and Government reports like "Learning without Burden".

The document itself as a whole is divided into the following five areas/Chapters

- Perspective of NCF
- Learning and Knowledge
- Curriculum Areas, School Stages and Assessment
- School and Classroom Environment

• Systematic Reforms

In its perspective of NCF, the document tries to emphasize the fact that learning has become a source of burden and stress on children and their parents is an evidence of a deep distortion in educational aims and quality. To correct this distortion, the present NCF proposes five guiding principles for curriculum development :

(i) Connecting knowledge to life outside the school ; (ii) ensuring that learning shifts away from rote methods ; (iii) enriching the curriculum so that it goes beyond textbooks ; (iv) making examinations more flexible and integrating them with classroom life ; and (v) nurturing an overriding identity informed by caring concerns within the democratic polity of the country. Discussions carried out in subsequent chapters bring out useful viewpoints, observations and recommendations on the various aspects of school education.

In its third chapter entitled as "Curriculum Areas, School stages and Assessment", the document has provided its view and visions about the assessment of the learning outcomes of the students resulted through their schooling at one or the other stage. In its chapter fifth entitled as "Systematic Reforms" it has discussed about reforms in the prevalent system of examination.

The main things emphasized or vision put up by this document in connection with the assessment of learning outcomes of the students may be outlined as below.

A. Examination Reforms – Need and Essentials

The prevalent system of assessment or evaluation of learning outcomes of the students are dominated by an external system of examination that has been responsible for making the task quite stressful and anxiety ridden to the students. It has been unable to provide the needed feedback to the students and the educational system for carrying out the teaching-learning process in a meaningful and productive ways. For this purpose there is a need of introducing systematic reforms in the prevalent system of examination in the manner like below.

1. Reforms regarding paper setting : In order to improve the validity of current examinations, the entire process of paper setting needs to be overhauled. The focus should shift to framing good questions rather than mere paper setting. Such questions need not be generated by experts only. Through wide canvassing, good questions can be pooled all year round, from teachers, college professors in that discipline, educators from other states, and even students. These questions, after careful vetting by experts,

could be categorised according to level of difficulty, topic/area, concept/competency being evaluated and time estimated to solve. These could be maintained along with a record of their usage and testing record to be drawn upon at the time of generating question papers.

2. Reforms about examining and reporting : Compelling teachers to examine paper without offering adequate remuneration makes it difficult to motivate them to ensure better quality and consistency in evaluation. Considering that most boards are in good financial health, funding issues should not come in the way of improving the quality of evaluation. With computerisation, it is much easier to protect the identity of both examinee and examiner. It is also easier to randomise examination scripts given to any particular examiner, thus checking malpractices and reducing inter-examiner variability. Malpractices such as cheating with help from outside the examination hall can be reduced if candidates are not permitted to leave the exam centre in the first half time, and also are not permitted to carry question papers out with them while the examination is still going on. The question paper can be made available after the examination is over.

Computerisation makes it possible to present a wider range of performance parameters on the marksheet—absolute marks/grades, percentile rank among all candidates taking the examination for that subject, and percentile rank among peers (e.g. schools in the same rural or urban block). It would also be possible to analyse the quality and consistency of various examiners. The last parameter, in particular, we believe to be a crucial test of merit. Making this information public will allow institutions of higher learning to take a more complex and relativist view of the notion of merit. Such analysis will promote transparency. Requests for re-checking have declined dramatically in places where students have access to their answer papers in either scanned or xeroxed form, on request, for a nominal fee.

3. Emphasis on school based and Internal Assessment : There is a need for getting shifted towards school based assessment, and devise ways in which to make internal assessment more credible. Each school should evolve a flexible and implementable scheme of Continuous and Comprehensive Evaluation (CCE), primarily for diagnosis, remediation and enhancing of learning. The scheme should take, into account the social environment of and the facilities available in the school.

Sensitive teachers usually pick up the unique strengths and weakness of students. There should be ways of utilising such insights. At the same time, to prevent abuse by schools (as is currently the case in practical examinations), they could be graded on a relative, not an absolute, scale.

and must be moderated and scaled against the marks obtained in the external examination. More research is required on development, teacher training and relevant institutional arrangements.

B. Assessment and Evaluation

The task of assessment and evaluation needs to be redesigned in terms of its purposes, methodologies and scope in the manner given below.

1. The Purpose of Assessment

- The purpose of assessment is necessarily to improve the teaching-learning process and materials, and to be able to review the objectives that have been identified for different school stages by gauging the extent to which the capabilities of learners have been developed.
- For realizing the purposes or objectives of school education at different stages the system of evaluation should be able to provide needed feedback on scholastic and non-scholastic areas. This can be achieved properly only if the teacher is armed with not only the techniques of assessment but also the parameters for evaluation and the various tools that will be employed.
- In addition to judging the quality of the student's academic achievements, a teacher would also need to collect, analyse and interpret their performances on various measures of the assessment to come to an understanding of the extent and nature of the student's learning in different domains.
- Besides tests and examinations, routine activities and exercises can be employed effectively to assess learning.
- Regular reporting about assessment help in getting learners well informed about their progress and serve to provide feedback to parents about the quality of learning and the development and progress of their wards.
- Besides formative assessments during the session, there should be a credible summative assessment at the end of the session for reporting and certifying the completion of a course of study, providing other schools and educational institutions, the community and prospective employers with information regarding the quality and extent of learning.
- In its diagnostic aspect evaluation should cater to the need of remedial teaching. However, the term remediation needs to be restricted to specific/special programmes that enable children who are having a problem with literacy/reading (associated with reading failure and later with comprehension) or numeracy (especially the symbolic

aspects of mathematical computation and place value) Teachers require specific training for effective diagnostic testing that can be of assistance in remediation efforts. Similarly, remedial work should require specifically developed materials and planning so that the teacher is able to give one-on-one time to work with the child, beginning with what she/he knows and moving to what she/he needs to learn, through a continuous process of assessment and careful observation.

2. Assessing Learners : The learners should not be assessed with the traditional tests and examinations for the memorized facts and textbook-based learning. Their assessment and evaluation should be quite comprehensive to indicate the progress of the learner towards their wholesome development. We need to redefine and use new parameters for evaluation and feedback. In addition to the learner, achievement in specific subject areas, assessment would need to encompass attitudes to learning, interest and the ability to learn independently.

3. Assessment in the course of Teaching : There should be a continuous ongoing observational and qualitative assessment of children and preparation of the needed report card at the hands of the teachers. The task of maintaining daily diary based on observation may help well a teacher in keeping a continuous and comprehensive evaluation report of the children. In addition attempts can also be made to keep samples and notes of the child's work at different stages for providing both the teacher and the learner himself with a systematic record of his learning progress.

4. Curricular areas that cannot be tested for marks : Quantitative assessment *i.e.* providing scores or marks for the performances or achievements of the students in one or the other curricular or co-curricular areas may not be possible every time. There may be occasions where the students may demonstrate qualitative improvement in their behaviour and development like improvement in health, moral behaviour etc that could not be assigned numerical marks. As a result, qualitative assessment or evaluation should also be made an integral part of the system of assessment besides the routine system of quantitative evaluation.

5. Design and conduct of Assessment : NCF 2005 has highlighted the need and procedure of designing and conducting assessment in a more credible and valid ways competent enough for gauging learning in a more appropriate manner. The types of questions set for the assessment need to be attended carefully for this purpose. There needs to be improvement in the conduct of examination and the new practices like open book examination, on demand examination etc. should be tried.

6. **Self-assessment and Feedback :** The role of assessment is to provide feedback to both teacher and learners about their teaching and learning and such feedback should constantly be available to them by a variety of ways including tests and examinations such as

- (i) Grading and correction carried out in the presence of students and providing feedback on the answers they get right and wrong, and why
- (ii) Asking students about why they answered particular question in a particular way
- (iii) Asking students to reflect on their learning experience *i.e.* comment on the totality of their experience regarding their learning.
- (iv) Asking students to provide assessment of what they can or cannot do well.
- (v) Providing qualitative statement for reporting marks or grades earned by the students for having more clarity and openness in assessment and feedback.
- (vi) Giving due recognition of the self-assessment of the students in the preparation of their progress report.

7. **Areas that require Fresh thinking :** There exists a number of things in the assessment of learning that need a close look or fresh thinking on the part of planners and researchers such as

- (i) There are areas or aspect of students learning for which we still do not have reliable and efficient instruments such as assessing learning carried out in groups, learning in areas such as theatre, work and craft where skills and competencies develop over longer time scales and require careful observation.
- (ii) Considerations about the implementation of continuous and comprehensive evaluation scheme in an effective way as not to load students with stress by reducing all their activities into items for assessment or making them experience the teacher's power.
- (iii) Need of evolving and maintaining credibility in assessment.

8. Assessment at different stages :

(i) **Upto Class II :** There should not be any test or examination (oral or written). Their learning should be assessed through qualitative judgement of their progress.

(ii) **Class III to Class VIII :**

- Use of variety of methods including oral and written tests and observation device.

- Assigning of Grades or marks alongwith the qualitative judgements of achievement in scholastic and non-scholastic areas
 - Children's own self-evaluation as a part of the report card from class V onwards.
 - Emphasis on short tests from time to time (criterion based) rather than examinations upto class VI
 - Commencement of term-wise examinations from class VII onwards.
 - Showing on the progress card (i) general observations on health and nutrition (ii) Specific observations on the overall progress of the learner and (iii) Information and advice for the parents.
- (iii) **Class IX to Class XII :**
- Using tests, examinations and project reports alongwith self-assessment for the knowledge based areas of the curriculum.
 - Using observation and self-evaluation for other areas.
 - Showing on the progress report a much more analysis about the students, various skills/knowledge areas and percentiles, etc. (Helping them to focus on present and planning for the future).

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. What is National Curriculum Framework (NCF)-2005 ? Discuss its views and vision regarding examination reforms and assessment for learning.
2. What type of examination reforms have been suggested under the document provided by NCF-2005 ?
3. Outline the views and vision of NCF-2005 regarding the following aspects of assessment and evaluation.
 - (i) The purpose of assessment (ii) Assessing learners (iii) Design and conduct of assessment (iv) Assessment in the course of teaching (v) Curricular areas that can't be tested for marks (vi) Self-assessment and feedback (vii) Areas that require fresh thinking and (viii) Assessment at different stages.

B. Short Answer Type Questions

1. What is National Curriculum Framework (NCF)-2005 ?
2. Name the type of examination reforms suggested in NCF-2005.
3. What is the purpose of assessment in view of NCF-2005 ?

4. Name the assessment areas that require fresh thinking in view of NCF-2005 ?
5. Point out the type or mode of assessment mentioned in NCF-2005 for one of the following stages.
(a) Upto class II (b) From class III to VIII (c) From class IX to XII
6. Name the curricular areas that can't be tested for marks as mentioned in NCF-2005
7. Point out in brief the design and conduct of assessment as mentioned in NCF-2005.

Bloom's Taxonomy of Educational Objectives

Chapter Outline

- Meaning of Instructional Objectives
- Relationship of Instructional Objectives with the Educational Aims and Educational Objectives.
- Taxonomy of Educational Objectives
 - Taxonomy of Objectives in the Cognitive domain
 - Taxonomy of Objectives in the Affective domain
 - Taxonomy of Objectives in the psychomotor domain
- Revised Bloom's Taxonomy (2001) for Instructional Objectives
- Study Questions

Meaning of Instructional Objectives

At the time of imparting instruction i.e. teaching learning of a particular lesson, unit or subunit of a subject, the teacher has to place before him some definite and very specific objectives within a class-room period and resources in hand. Through these specific classroom teaching learning objectives, known as Instructional objectives, a teacher tries to bring desired changes in the behaviour of his pupils. In this way, the term Instructional objectives in relation to the teaching of a particular subject may be defined as "a group of statements formulated by a teacher for describing what the pupils are expected to do or will be able to do once the process of classroom Instruction is over."

In fact what a teacher obtains as Instructional output in the teaching-learning process are nothing but some type of behavioural changes in the pupils that may be expected as a result of the Instruction related with a particular lesson, unit or subunit of the subject. Instructional objectives are thus nothing but description of the pupils terminal behaviour expected out of the on going class room Instruction.

Relationship of Instructional Objectives with the Educational Aims and Educational Objectives

All teaching beings with some kind of planning and aimed at the realization of some purposes or goals. These goals may be as mundane as keeping the students quiet for an hour or as lofty as teaching morals or spiritual values. They may be limited to achieve the specific class-room teaching purposes or broadened to achieve national targets or international understanding through a process of education. The terms like educational aims or goals, educational objectives and instructional objectives are used for describing the purposes or destination to which an educational process or teaching-learning act is aimed at. A teacher must be very clear about these terms for serving the specific needs related to a particular teaching-learning situation. Let us therefore, try to differentiate between these terms.

Educational aims or goals are the broad purposes, goals or targets planned to be achieved through education. Sometimes they may take the form of lofty ideals, may speak of the perfect condition, which may be attained or not e.g. attainment of salvation, establishment of a classless society, removal of poverty, ignorance and illiteracy from the earth, etc. They are almost vague and indefinite and their attainment is quite difficult or rather impossible through the existing classroom conditions or educational structure.

Instructional objectives are very narrow and specific. They are definite, tangible, precise, clear and functional. They are predetermined and formulated in such a way that their attainment becomes quite practicable through the usual classroom teaching within the stipulated period of fixed duration. They are the desired learning or teaching outcomes and are always stated in terms of expected pupil's behaviour or desired behavioural changes. They are, therefore, may termed as teaching-learning objectives or behavioural objectives. The main purpose of these objectives is to provide statements of skills, concepts or the behaviour that the learners are expected to demonstrate after going through particular instruction.

Educational objectives fall midway between educational goals and instructional objectives. They are more specific and definite than the educational aims or goals but less specific and much wider than the classroom instructional objectives. They usually serve the genral purposes of education. Their attainment is quite possible within the educational structure and means. They differ from nation to nation and society to society. Development of democratic leadership, vocational efficiency, national integration, secularism etc. are some of the examples of educational objectives. They are made to serve the cause of the individual and society and help in the proper

development of the cognitive, conative and affective domains of one's personality through the general scheme of education and long-term planning.

In fact, instructional objectives, educational objectives and educational goals represent a Hierarchical order as shown below

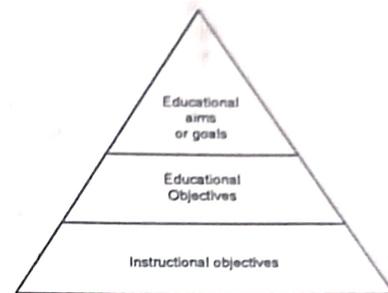


Figure 3.1. Hierarchical order of objectives

The above figure illustrates that instructional objectives are the basic targets that could be easily achieved within the limited period and means while educational aims or goals are quite broad-based and lofty.

The narrower or broader view-points or area of influences may be further illustrated as shown in the diagram below :

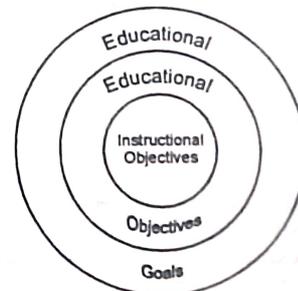


Figure 3.2. A diagrammatic view of objectives

According to the above view, instructional objectives may be sub-categorised submerged in the reservoir of educational objectives which in turn are further submerged in the ocean of educational goals.

As demonstrated earlier, instructional objectives specifying the specific outcomes of a teaching act may be grouped or categorized into relatively broader groups or categories known as educational objectives. These objectives are related with all the three aspects of individual's behaviour—conative, cognitive and affective also called as domains of human behaviour. Going other way, the educational objectives may be analysed in terms of the specific and precise learning or teaching outcomes appropriate to classroom action.

Many attempts have been made by the different scholars in this direction but the attempt made by Bloom and his associates Bloom, et. al., 1956) is appreciable. Bloom was the editor of the first volume of "Taxonomy of Educational Objectives," produced by an American Committee of College and University Examiners.

"Taxonomy" means a system of classification and in this sense Bloom's Taxonomy presents a system of classification of the objectives in the similar way as Dewey's Decimal system tends to classify a number of books in a library.

The taxonomy, of educational and instructional objectives has been worked out on the assumption that the teaching-learning process may be conceived as an attempt to change the behaviour of the pupils with respect to some subject matter or learning experiences. Behaviour is divided into three domains—Cognitive (knowing), affective (feeling) and psychomotor (doing). The taxonomy of educational and instructional objectives have also been considered to be belonging to these three domains.

The taxonomy related to cognitive domain has been presented by Bloom (Bloom, et. al., 1956), the second related to affective domain by Krathwohl, Bloom and Masia (Krath Wohl, et. al., 1964) and the third related to psychomotor domain by Harrow (Harrow, 1972) and Simpson (1966).

For the purpose of this text we hereby reproduce the condensed forms of these taxonomies.

Taxonomy of Educational Objectives in the Cognitive Domain

Taxonomy of objectives in the cognitive domain, given by Bloom and his associates (1956) tries to provide the most difficult but highly promising task of classifying Instructional objectives on a continuum from the simple to the relatively complex. He classified these objectives into six categories arranged from the lower to the highest level of functioning as described below in table 3.1.

TABLE 3.1 Taxonomy of Objectives in the Cognitive Domain

1. Knowledge :	
(a) Knowledge of specifics :	(i) Knowledge of terminology. (ii) Knowledge of specific facts.
(b) Knowledge of ways and means of dealing with specifics.	(i) Knowledge of conventions. (ii) Knowledge of trends and sequences. (iii) Knowledge of classifications and categories. (iv) Knowledge of criteria. (v) Knowledge of methodology.
(c) Knowledge of universals and abstractions in a field.	(i) Knowledge of principles and generalizations. (ii) Knowledge of theories and structures.
2. Comprehension :	
	(a) Translation (b) Interpretation (c) Extrapolation.
3. Application	
4. Analysis :	
	(a) Analysis of elements (b) Analysis of relationships (c) Analysis of organisational principles.
5. Synthesis :	
	(a) Production of unique communication. (b) Production of a plan or proposed set of operations (c) Derivation of a set of abstract relations.
6. Evaluation :	
	(a) Judgement in terms of internal evidence (b) Judgement in terms of external criteria.

Let us try to elaborate the above taxonomy of objectives of cognitive domain given by Bloom for its clarity and understanding.

1. Knowledge. It represents the lowest level of the objectives belonging to the cognitive domain and primarily aims for the acquisition of the knowledge concerning.

- (i) Specific facts, terminology, methods and processes and
- (ii) Generalized principles, theories and structures.

The knowledge objectives mainly call for the recall and recognition level of one's memory and therefore their evaluation is primarily made through a simple recall or multiple choice type questions.

2. Comprehension. Comprehension is based upon the knowledge. If there is no knowledge, there will be no comprehension. On the ladder of the acquisition of cognitive abilities its level is little higher than the knowledge. Specifically, it means the basic understanding of the facts, ideas, methods, processes, principles or theories, etc. As a result, what is communicated to a learner, he may :

- (i) translate or summarize the communicated knowledge in his own words ;
- (ii) interpret *i.e.* cite examples, discriminate, classify, variety or generalize and
- (iii) extrapolate *i.e.* estimate or understand the use of knowledge and extend it to other subjects and fields.

3. Application. The knowledge is useful only when it is possible to make it employed. The application of an idea, principle or theory may be made possible only when it is grasped and understood properly. Therefore, the category of application automatically involves both the earlier categories *i.e.* knowledge and comprehension. Under this objective the learner is required to acquire the ability to make use of the abstract or generalized ideas, principles in the particular and concrete situations.

4. Analysis. Analysis refers to an understanding at higher level. It is a complex cognitive process that involves knowledge, comprehension as well as application of an ideas, fact, principle or theory. Through the realization of these objectives the learner is expected to acquire the necessary skill in drawing inferences, discriminating, making choices and selection and separating apart the different components or elements of a concept, object or principle.

5. Synthesis. The objectives belonging to this category aim to help the learner to acquire necessary ability to combine the different elements or components of an idea, object, concept, or principle as to produce an integrated picture *i.e.* a figure of wholeness. As a result he may be expected to propagate or present a theory or principle by creating something new or

originate some novel thing or idea after synthesizing all what is known to him earlier. In this way, it calls for the creativity aspect of the cognitive abilities and therefore may be considered definitely a higher level of learning involving knowledge, comprehension, application as well as analysis.

6. Evaluation. This category of objectives aims of developing in the learner the ability to make proper value judgement about what has been acquired by him in the form of knowledge, understanding, application, analysis and synthesis. It represents definitely the highest level of the objectives belonging to the cognitive domain and involves all the five categories described earlier. As a result the learner is expected to take proper decision about the quantitative and qualitative value of a particular idea, object, principle or theory. He may arrive at an appropriate decision about the matter and methods by making use of all the cognitive abilities acquired through the earlier categories of cognitive objectives.

Taxonomy of Objectives in the Affective Domain

Taxonomy of objectives in the Affective Domain proposed by Krathwohl, Bloom and Maria (1964) is presented in the table 2.2.

Table 3.2 Taxonomy of Objectives in the Affective Domain arranged from lowest to highest level of functioning.

1. Receiving (Attending)	(a) Awareness (b) Willingness to receive (c) Controlled or selected attention
2. Responding	(a) Acquiescence in responding (b) Willingness to respond (c) Satisfaction in response
3. Valuing	(a) Acceptance of a value (b) Preference for a value (c) Commitment
4. Organization	(a) Conceptualization of a value (b) Organisation of a value system
5. Characterization by a value or value Complex	(a) Generalized set (b) Characterisation

Let us try to elaborate further the above classification for its clarity and understanding as below :

1. Receiving. It represents the initial category for the objectives belonging to affective domain. For the inculcation of certain interests,

attitudes, values or ideas it is essential that learner should be made to receive or attend the desired ideas, events or objects. This category points out towards this necessity and takes into consideration three types of following sequential activities :—

- (i) Firstly, the learner is sensitized or made aware about the existence of certain stimuli.
- (ii) Then the desired intention or willingness for receiving or attending the stimuli is created in the learner.
- (iii) Lastly, the efforts are made for the control of the attention of the learner. He may be trained to pay selective attention and sustain it for a desired period.

2. Responding. It represent the second level of the objectives for the categories belonging to affective domain. Once a learner receives or attends to a particular idea, event or thing he must be made to respond to it as actively as possible. The responses here do not confine itself in just paying attention or arousal of a simple intention or desire of getting a thing, as in the first category of receiving but manifest themselves in the active behaviour like obeying, answering, reading, discussing, recording, writing and reacting to a stimulus, etc.

3. Valuing. When one attends as well as responds to a particular thing, idea or event he is naturally drifted towards taking value judgement about that thing, idea or event. Therefore, this category of valuing depends upon both the former categories *i.e.* receiving and responding. Here the learner is expected to imbibe a definite value pattern towards different ideas, events and objects. In practice the objectives belonging to this category are usually concerned with the development of typical value patterns, attitudes, etc.

4. Organising. This category of objectives concern with the construction of relatively enduring value structure in the learner by organising and synthesizing the different value patterns imbibed by him from time to time. Ultimately this category of objective leads the learner to form a set value structure or philosophy of life.

5. Characterizing by a value or value complex. It is the highest level category of the objectives belonging to the affective domain. Upto this stage, the learner is able to imbibe all the essential affective behaviour *i.e.* various interests, attitudes, values, value complex or value patterns, a permanent set value structure and therefore, all the earlier categories, are automatically involved in the objectives of this category. At this stage, the learner is destined to imbibe typical characteristics of his individual character *i.e.* life style of his own. In fact it is the end point or ultimate goal of the process of education.

Taxonomy of Objectives in Psychomotor Domain

The classification of psychomotor objectives was first produced by Simpson (Simpson, 1966) and latter modified by Harrow (1972). Those given by Harrow are being described in the following pages under six different categories arranged from lowest to the highest levels of functioning.

1. Reflex Movements. Reflex movements may be considered as the involuntary motor responses to the various stimuli in the environment. Examples of such reflex movements or actions are : the jerking of hands, the closing of eye lid, stretching of the arms, etc. These movements represents the lowest level of the psychomotor behaviour. They are largely controlled by the autonomous nervous system. However, they are very much essential not only for the development of psychomotor abilities but also for the survival of the human beings.

2. Basic Fundamental Movements. These fundamental movements are just a step ahead of the simple reflex movements. They are not so inborn and innate as the reflex movements but a child may be seen to demonstrate such movements in his very early days of life. Their movements in the form of kneeling, creeping, stumbling, walking, jumping, moving hands, neck, heads, etc. may be named as basic fundamental movements. They represent the simple basic movements of the body almost requiring no serious attempts or skilled practice for their occurrence. In the later years of our life, these movements are made as a result of obeying certain kinds of orders.

3. Perceptual Abilities. The development of motor abilities related with the phenomenon of perception belongs to this category of objectives. When some meaning is attached to sensation, it is termed as perception. As a result, the learner is able to derive useful meaning out of the exposure of their senses to various stimuli in the environment. His bodily movements are then governed and controlled by his perceptual abilities. Whatever is perceived by him through his senses becomes an ignition point for his motor behaviour. Such type of behaviour is a learned behaviour. It is always acquired through experience and systematic training.

4. Physical Abilities. For an effective motor behaviour, there is an urgent need of the development of desirable physical abilities. If one has adequate physical stamina and abilities, he may go ahead in the task of improving his psychomotor behaviour. Therefore, this category of objectives aims to develop the various physical abilities of the learners like tolerance to bear and stand against rough weather ; to do hard labour, to carry the large load, to bend an article, to demonstrate one's physical power in starting, stopping or running an object or machine, etc.

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5. **Skilled Movements.** Skilled movements are those complex bodily movements which help in performing the skilled tasks. These movements are to be acquired through an organised and systematic learning process. Their acquisition requires an intelligent understanding and sufficient drill or practice work on the part of the learner. The art of dancing, diving, driving, playing the musical organs, skating, typing, swimming, tailoring, etc. represent such skilled movements. The development of the abilities concerning such skilled movements depends upon the development of the motor abilities described under all the earlier four categories.

6. **Non Discursive Communication.** This category represents the highest level of the psychomotor behaviour. The bodily movements are hereby integrated with the inner feelings and affective behaviour of the learner. In this way, the non-discursive communication may be defined in terms of the overt behaviour activities related with the communication of affective behaviour feelings or emotions. This communication may range from a simple behaviour expressible through posing or facial expression to a complex behaviour performed through a highly sophisticated classical dance, sketching, painting or acting.

An Alternative Taxonomy of Psychomotor Objectives

An alternative taxonomy in the psychomotor domain has been proposed by the famous American educationist Dr. R.H. Dave (1969) in the shape of a working hypothesis as shown in Table 3.3.

Table 3.3. Taxonomy of psychomotor objectives

1. <i>Imitation</i>	
(a) Impulsion	(b) Overt repetition
2. <i>Manipulation</i>	
(a) Following direction	(b) Selection
(c) Fixation	
3. <i>Precision</i>	
(a) Reproduction	(b) Control
4. <i>Articulation</i>	
(a) Sequence	(b) Harmony
5. <i>Naturalization</i>	
(a) Automatism	(b) Interiorization

Let us have a necessary explanation for the above steps.

Imitation

For the learning of a psychomotor activity, *i.e.* drawing or surveying skill in social studies, the task begins with the imitation of observed acts. The child observes the demonstrated behaviour related to drawing of a map outline, measurement of latitude and longitude on a globe. He feels an inner push or an impulse (by having an inner rehearsal of the psychomotor activities) to imitate the action. It is followed by the overt repetition (imitation) of the demonstrated behaviour.

Manipulation

This second category of psychomotor objectives emphasizes manipulation on the part of the learner for the acquisition of skills by following directions, performing selected action and fixation of performance through necessary practice.

Precision

In the third category of psychomotor objectives, the learner is able to perform skilled acts or motor activities with a desired level of precision (accuracy, exactness and right proportion) and as such may be said to reach a higher level or refinement in reproducing a given act or skilled task.

Articulation

It is the fourth category in the hierarchy of learning the psychomotor activities or skills. At this stage, the learner becomes capable of coordinating a series of acts by establishing appropriate sequence and accomplishing harmony or internal consistency among different acts.

Naturalization

It is the highest stage reached in terms of the development or proficiency acquired in the learning of a skill or psychomotor act. One can now perform a single act or a series of articulated acts with a greater refinement, ease and convenience as automatic and naturally as possible.

Revised Bloom's Taxonomy (2001) for Instructional Objectives

We have mentioned in this chapter that Benjamin S. Bloom alongwith his associates presented a taxonomy of educational objectives related to cognitive domain of the learners' behaviour in 1956. In this taxonomy he tried to classify cognitive processes into six categories arranged from the lowest to the highest level of functioning. The categories or levels used were (i) Knowledge (ii) Comprehension (iii) Application (iv) Analysis (v) Synthesis (vi) Evaluation.

With the passage of time, however, the scholars in this field felt a need of revising this taxonomy put up in 1956. As a result, L.W. Anderson, a

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former student of Bloom and D.R. Krathwohl, one of the co-authors of Bloom's book, let a team of experts in revising Bloom's taxonomy, 1956. In 2001, they published the first major revision of the Bloom's cognitive taxonomy in the form of a book – *A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives* (New York: Allyn and Bacon). The revised taxonomy also has six divisions of the cognitive processes much like the former one. However, it differs in nomenclature and functionality in some significant ways. Let us see how, but for this purpose let us have a view of what has been presented in this revised taxonomy in terms of the categories and their hierarchical order.

1. **Remembering** : Remembering or recognizing something without necessarily understanding, using, or changing it.
2. **Understanding** : Understanding the material being communicated without necessarily relating it to anything else.
3. **Applying** : Using a general concept to solve a particular problem.
4. **Analyzing** : Breaking something down into its parts.
5. **Evaluating** : Judging the value of material or methods as they might be applied.
6. **Creating** : Creating a new thing/idea with the integration or coordination of different ideas.

Table 3.4. Comparison between Bloom's Taxonomy, 1956 and its revision 2001

1956's Taxonomy (The categories with their hierarchical order)	2001's Taxonomy (The categories with their hierarchical order)
1. Knowledge	1. Remembering
2. Comprehension	2. Understanding
3. Application	3. Applying
4. Analysis	4. Analysing
5. Synthesis	5. Evaluating
6. Evaluation	6. Creating

The analysis of the contents provided in these two versions of Taxonomy may help us in drawing following conclusions.

1. Both the taxonomies have tried to classify the cognitive processes related to students learning into six categories in a hierarchical order arranged from the lowest to highest.

Bloom's Taxonomy of Educational Objectives

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2. They differ from each other in terms of nomenclature as under
 - (i) The revised taxonomy has used verbs in place of nouns used in the original taxonomy.
 - (ii) The word knowledge has been replaced by remembering, comprehension by understanding, synthesis by evaluating and evaluation by creating. The logic for this replacement has been provided as below.
 - Since we are providing classification for the cognitive processes undergoing at the time of learning in learner's mind. We have to see what actually goes inside his mind in a sequential way. He first tries to remember what he has already learned or memorized. It may exist in the form of knowledge but the cognitive process at this time he undergoes is remembering. It is therefore needed to replace the word knowledge with the word remembering.
 - With the help of remembering (banking upon his past experiences or learning) the learner then undergoes a process named as understanding of the new learning material. The word understanding represents an active cognitive process in a more proper way unable to be conveyed through the term comprehension.
 - When one is able to understand, apply and analysis a facts, concept or principle related to a piece of knowledge, then it should be naturally followed by a cognitive process named as evaluating. Here he can examine, test, verify and evaluate what has been learned by him through the ongoing former cognitive stages like remembering ; understanding, applying and analysing. The word 'synthesis' used in original taxonomy does not suit much to describe this cognitive functioning stage hence it has been replaced by the term evaluating.
 - The word creating has been used for describing the final stage of one's thinking or cognition in his learning. This is the highest stage of one's cognitive functioning in his learning that makes him competent enough to create something new or novel out of his learning endeavour. The former term 'evaluation' used in the original version is unable to describe such final creative functioning of the learner.
3. The another major difference between the original and revised taxonomies lies in the fact that where the revised taxonomy is two dimensional, the original has only one dimension. There are two dimensions identified as the knowledge dimension (the type of knowledge to be acquired) and the cognitive process dimension (the type of cognitive process used in knowledge acquisition) in the revised taxonomy. Moreover knowledge of something related to a subject

may be classified into four distinct dimensions such as factual knowledge (knowledge about facts), conceptual knowledge (knowledge about concepts), procedural knowledge (knowledge regarding the processes involved) and metacognitive knowledge (higher order knowledge termed as knowing about one's knowing or knowledge). For the cognitive process dimensions, revised taxonomy already prescribes six divisions in the name of remembering, understanding, applying, analyzing, evaluating and creating. As a result, the intersection of the knowledge dimensions (Four) and cognitive process dimensions (six) may provide twenty four cells making the taxonomy table two dimensional as shown below.

Table 3.5. Two Dimensional Table of Revised Bloom's Taxonomy

(Revised Taxonomy includes cognitive processes operating on different dimensions of knowledge. The verbs in this table are examples of action verb used at varying levels of knowledge acquisition)

Knowledge Dimension	Cognitive Process Dimension					
	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Factual knowledge	List	Summarize	Classify	Order	Rank	Combine
Conceptual knowledge	Describe	Interpret	Experiment	Explain	Assess	Plan
Procedural knowledge	Tabulate	Predict	Calculate	Differentiate	Conclude	Compose
Metacognitive knowledge	Appropriate use	Execute	Select strategy	Change strategy	Reflect	Invent

Source : Anderson and Krathwohl (2001)

In this way, revised Bloom's Taxonomy has been capable enough to pin point the type of cognitive processes (proceeding in a hierarchical order) undergoing at the time of learning or acquiring the knowledge of something at its varying levels.

Writing objectives in behavioural terms in the revised taxonomy

We need action verbs for writing the instructional objectives of a topic in a teaching subject. The relevant action verbs for writing

instructional objectives in behavioural terms under the different categories of cognitive process alongwith their sub-categories have been provided in the table 3.6. These can be utilized for writing the needed instructional objectives for the teaching-learning of one or the other topics of a subject.

Table 3.6. Category and Sub-categories of cognitive processes and the associated Action Verbs in the revised Taxonomy.

Category of Cognitive process	Sub-category Cognitive process	Associated Action Verbs
Remembering	Recognising Recalling Finding	List, Name, Define, Label, Recall, Recognize, Reproduce, Select, State, describe, identify, Locate, underline etc.
Understanding	Interpreting Exemplifying Classifying Inferring Comparing Explaining	Explain, Interpret, Summarize, Exemplify, Compare, Classify, Distinguish, Illustrate, Indicate, Predict, Estimate, Paraphrase, Infer, Justify, Judge, Transform, etc.
Applying	Executing Implementing	Execute, Implement, Solve, Relate, Demonstrate, Prepare, Modify, Show, Use, Apply, Choose, Construct, Discover, Find, Generate, Manipulate, Compute, Perform, Select, etc.
Analysing	Differentiating Organising Attributing	Analysis, Associate, Compare, Conclude, Contrast, Criticise, Differentiate, Identify, Justify, Point out, Resolve, Select, Separate, Organise, Distinguish, Illustrate, Attribute, Outline, Infer etc.
Evaluating	Checking Critiquing	Judge, Check, Criticise, Evaluate, Hypothesise, Experiment, Defend, Determine, Recognize, Relate, Summarize, Support, Verify Test, Monitor, Apprise, Interpret, Decide etc.
Creating	Generating Planning Producing	Design, Construct, Reconstruct, Invent, Plan, Discover, Generate, Reorganise, Compose, Modify, Create, Exhibit, Produce, Suggests etc.

STUDY QUESTIONS**A. ESSAY TYPE QUESTIONS**

1. Throw light on the meaning and concept of instructional objectives by differentiating them from the terms educational aims and educational objectives.
2. What is taxonomy of educational objectives? Provide the taxonomies of objectives in the cognitive domain as provided by Bloom and his associates in 1956.
3. Discuss the revised Bloom's taxonomy (2001) by differentiating it from the earlier one given in 1956.
4. Discuss the taxonomy of educational objectives in affective and psychomotor domains.

B. SHORT ANSWER TYPE QUESTIONS

1. What are instructional objectives?
2. Discuss the meaning of educational aims/educational objectives.
3. What is taxonomy of educational objectives?
4. Name the six categories provided in Bloom's Taxonomy (1956) of objectives in the cognitive domain.
5. Name the six categories provided in revised Bloom's taxonomy (2001) related to educational objectives in the cognitive domain.
6. Name the categories belonging to taxonomy of educational objectives in affective domain as proposed by Krathwohl, Bloom and Maria (1964).
7. Name the categories belonging to the taxonomy of educational objectives in psychomotor domain as proposed by Simpson (1966) or Dave (1969).
8. Name the important attributes distinguishing revised Bloom's taxonomy (2001) from the original one proposed in 1956.

4**Tools and Techniques of Evaluation or Assessment****Chapter Outline**

- Introduction
- Different tools and techniques for Assessing learning outcomes
 - Observation
 - Interview
 - Rating Scale
 - Questionnaire
 - Checklist
 - Cumulative Record
- Characteristics of a good Assessment tool
- Study Questions

Introduction

Tools and techniques of assessment or evaluation represent those ways and means which help measure and assess the teaching-learning outcomes, *i.e.* to know the extent to which the desired behavioural changes have taken place in the learner. These changes, both quantitative as well as qualitative, occur in all the three domains—cognitive, conative and affective—of the behaviour of the learner. The teachers make use of so many formal and informal techniques for the measurement and assessment of the teaching-learning outcomes, which include :

- (a) Oral tests and examinations.
- (b) Practical tests and examinations.
- (c) Written tests and examinations consisting of essay, and objective and short answer type questions.
- (d) Techniques and devices such as observation, discussion, questionnaire, inventory, interview, checklist, attitude scale, rating scale, case study and projective techniques, etc.

- (e) Techniques and devices that make use of a variety of performance platforms for assessing the learning outcomes of the students such as projects, assignments, worksheets, practical work, performance based activities, seminars and reports etc.

In this chapter, we would like to throw light upon some of the techniques and tools put up in the last category (d) named as observation, interview, questionnaire, rating scale, checklist, and cumulative record.

Different Tools and Techniques for Assessing Learning Outcomes

Observation

For the assessment of changes in behaviour brought out in the affective domain of student's behaviour. We can appropriately make use of the observation tool or technique. Let us try to get acquainted with the nature and use of this tool.

What is Observation ?

Observation refers to a process of observing a thing, person phenomenon or event with the use of one's sensory organs for knowing something related to its nature and ways of behaving or occurrence. We can make use of our all the five senses — Sense of vision, hearing, touch, smell and taste for carrying out the task of observation on our part. However, in general, the two senses — Senses of vision and hearing are more commonly used in assessing the outcomes of the changes brought out in conative and affective behaviour of the students through the way and means of formal and informal education. We can watch and hear the things related to the performance of the students in various activities representing the changes introduced in conative and affective domain of their behaviour.

The Styles and Ways of Observation

Observation as a tool is employed in assessing the behavioural aspects of the subjects in a number of ways and styles classified in the manner given below :

- A. On the basis of the very nature of observation or formalities observed in observing
 - (i) Formal observation (ii) Informal observation.
- B. On the basis of the structural framework of the phenomena of observation involved in observation
 - (i) Structured observation (ii) Unstructured observation.

- C. On the basis of the degree of involvement of the observer
 - (i) Participant observation (ii) Non-participant observation.

Let us discuss these various types of observation in relation to the collection of information or data.

1. Formal observation : In such a type or style of observation, it is carried out in quite a formal way by observing the necessary formalities like (i) providing the information to the individual or individuals about the nature and purpose of the observation (ii) the date, timings and place of observation (iii) the names and introduction of the observers (iv) the necessary pre-preparation needed on the part of the subjects for such an observation just as showing of any maintained record or preparing them or their environment for such inspection etc. However, such a type of observation cannot prove more fruitful in terms of drawing some reliable and valid conclusions about one's behaviour or personality. For example, if we announce to the inmates of a hostel that we are going to have an inspection of their rooms regarding their habit of cleanliness on a particular date and time, such type of a formally announced observation will surely fail in its objective of knowing about the habit of cleanliness among the hostlers. The prior information, will automatically make them quite alert. Thus the cleanliness behaviour shown at the time of such formal observation will not be a true representation of their real behaviour. It will have an artificial mask with the aim of turning the results of the observation in their favour. Hence the reliability and validity of the collected information can remain in doubt for collecting data through the method of formal observation.

2. Informal observation : Contrary to the formal observation, informal observation is carried out in a quite informal, spontaneous and natural way. Here no prior information about the nature, purpose, timings and place of the observation is given to the individual or individuals. They are thus caught unaware, engaging in their behavioural activities in a quite usual and natural way. In such naturalistic observational situations we may have a relatively true picture of the behavioural characteristics and the state of things and events lying in one's environment.

3. Structured observation : As the name suggests, the observation process carried out in this type of observation is quite structured, fixed and pre-determined irrespective of the fact that it is organised in a formal or non-formal way. Processing of such observation essentially requires proper structuring and standardization of the conditions of observation by specifying (i) the things or events to be observed, (ii) data to be recorded (iii) the assisting tools e.g. checklists and rating scales to be employed

(iv) the recording devices like tape recorder, video makers, telescope etc. used.

4. Unstructured observation : The observation process adopted in such observation is totally unstructured *i.e.* no conditions or restrictions are imposed upon the observer in carrying out observation for the collection of information or data. The purpose of such unstructured observation is to provide a richer and more true spontaneous account of the things and events happening in one's environment with a lot of freedom and flexibility in his hand. It does not make use of the structured material/devices like checklist rating scales etc. for the observations of pre-determined things or events.

5. Participant observation : This type of observation requires on the part of the evaluator to play the role of a participant observer while observing a thing, event or phenomena in a particular observing situation. In observation actually the role of the observer may be placed on a continuum ranging from the complete participant to the complete non-participant *i.e.* complete participation to complete detachment as a mere observer. The role of the complete observer according to Gold (1958) is typified in the one-way mirror, the video cassette, the audio-cassette and the photograph, whilst complete participation involves researchers taking on membership roles (overt or covert) declaring or non-declaring his identity as the observer.

In this way, participant observation may be defined as a type of observation in which the observer takes the membership role of the group to be observed by declaring or not declaring his identity as an observer to the group. By joining the group thus he may share the observed situations as a visiting stranger, an attentive listener, an eager learner, or as a complete participant overt observer (registering recording and interpreting behaviour of the group). The participant observer, thus may found to play a double role. On one hand he acts and feels like other members of the group by being engaged in the group activities and on the other hand works as an observer to note down the things related to the behaviour of the members and events occurring in the group situations. For example, a teacher while assessing students may join them in the laboratory or workshop activities or accompany them on tour and excursion activities for having a close observation of them. Such a type of observation may provide good opportunity for the observation of the behaviour of the individuals. However, it suffers from a serious limitation as the presence of an observer may obstruct the natural and spontaneous flow of the behaviour activities of those individuals.

6. Non-participant observation : This type of observation tries to do away with the above cited defect or limitation of the participant observation. Here the observer observes the behaviour of the individuals in such a way that they may not have any idea about the observation of their behaviour in any way by one or the other observer. For this purpose as observer he may take his position on such a place in such a way, that while the individuals under observation may not see him but he can clearly watch and hear if possible all about their behaviour in action. There may be a screen or a curtain of such a nature as to help an observer in real observation while hiding his presence.

The use of some modern equipments like secret cameras, video recording, audio recording, etc. may also serve such purposes. While sitting at quite a far distance, he may also take the help of a telescope for a clear secret observation. Whatever means and methods may be employed by the observer, his motive in such an observation always remains to come into contact with the natural and spontaneous behaviour of the subject without making him aware of his presence.

Characteristics of a Good observer and his observation

In view of Best and Kahn (2010 : 312), the following standards should characterize observers and their observations :

- Observation is carefully planned, systematic, and perceptive. Observers know what they are looking for and what is irrelevant in a situation. They are not distracted by the dramatic or the spectacular.
- Observers are aware of the wholeness of what is observed. Although they are alert to significant details, they know that the whole is often greater than the sum of its parts.
- Observers are objective. They recognize their likely biases, and they strive to eliminate their influence on what they see and report.
- Observers separate the facts from the interpretation of the facts. They observe the facts and make their interpretation at a later time.
- Observations are checked and verified, whenever possible by repetition or by comparison with those of other competent observers.
- Observations are carefully and expertly recorded. Observers use appropriate instruments to systematize, quantify, and preserve the results of their observations.
- Observations are collected in such a way as to make sure that they are valid and reliable.

Utilizing observation Tool for Assessing Behavioural Outcomes

The use of the observation tool for the task of assessing behavioural outcomes involves the two systematic phases.

Phase I. Planning and Preparation for Observation : The success of an observation depends much on its proper planning and preparation. This initial task requires proper attention on the following aspects —

- What type of behavioural activities situations or events are to be assessed through observation ?
- How the observation work is to be carried out, what type of methods or resources will be used for such observation ?
- What type of situation or environment is to be maintained for carrying out effective observation ?
- How can the observation results may be made more reliable informative, objective and valid ?

Phase II. Execution of the Observations Task : This second step is related with the actual observation work done by the observer as per planning and pre-preparation made in the first step. Here as far as possible the best methods and techniques should be used for the observation of the behaviour depending upon the purpose of observation and availability of the resources and environmental situations at the time of observation. In this concern for obtaining better results, the following things should always be kept in mind —

- The subject should not have any idea that his behaviour is under observation. As far as possible his behaviour is to be observed in a quite naturalistic condition for deriving the sample of his most natural and spontaneous behaviour.
- The observation work must be carried out properly in a quite effective way. The eyes have to play a key role in such an observation. If possible, one should also try to hear about the behavioural activities in action.
- It is always better to make use of a telescope for viewing the activities of individuals specially while sitting at a far off place.
- There must be an adequate arrangement for using the modern observation equipments like cameras, video and audio recording. The use of these appliances not only helps in proper observation of the behavioural activities but proves an automatic recording device for the proper analysis and interpretation of the behaviour.

- It is not proper to rely over the results of a single observation for informing about the nature of the things, events or behaviour observed. For a desirable objectivity, reliability and validity, such observation work must be repeated by the same observer for a desirable number of times or it should be carried out by a number of different observers at one or a number of times.
- The recording about the nature of a thing, event or trait of a person should always be done side by side by the observer during the process of observation. The failure to do so prove quite costly as the observer may forget or miss some or the other important things or links regarding the observed phenomenon.

The observer may do it effectively with the help of noting down the things in short or in a symbolic way easily understood by him later on. He may also take the help of a checklist, and/or rating scale for tallying or marking the things to be observed in the observed phenomenon. However, in case he has to play the role of a participant observer, then the recording of the observed phenomenon may be proceeded in the manner below suggested by Lofland (1971).

- Make careful mental notes of all that is observed.
- Note down important events, words or quotes which are susceptible to memory lapses.
- As soon as possible, prepare full field notes by converting mental and jotted down notes into meaningful observational notes.

Interview

We all are acquainted well with the term interview. We take the help of interviews for providing entry to a specific course of learning and selection as well as promotion in services. It helps us to know about the potentials of the candidate with regards to their abilities and capacities, behavioural and personality characteristic for assessing their suitability to a course or job. In an interview, the candidate are made to answer the asked question and inferences are drawn about their suitability is selection to the quality of their responses and the manner in which these responses are given by them. We can ask question either in oral, written or both oral-written form and similar modes may also be adopted by the candidates as per demand of the interview procedure. The interview can take a form of discussion if a situation demands and as a result we may have enough opportunities for collecting information in depth from the interviewed candidates to derive necessary conclusion about the changes brought out in one's behaviour.

Types of Interviews

Personal Interview. Here the interviewer works directly on a face to face situation with a respondent. He has the full opportunity to probe or ask follow-up questions by taking the respondent in proper confidence.

Group Interview. Here the respondents work as a group, listening to each other's comments and answering the questions put up by the interviewer. Interviewer or some one from the group takes notes of the proceeding of the group-people do not provide interview on the individual basis.

Formats of the Interview

Interview in view of its structural organisation may be shaped in the following two forms.

- (i) Structured and standardized
 - (ii) Unstructured and non-standardized.
- (i) **Structured and standardized.** In this type of format the interview is got structured as well as standardized well in advance before put to use with the individuals for getting the information from the individuals as per need the survey study. This is done by taking care of the following.
- Selection of the appropriate questions put to the individuals.
 - Taking decision about the order and sequence of the asked questions.
 - To decide what type of answer or responses for an asked question will be able to provide the required information in the light of the objectives of the study.

In this way, by taking proper definite decisions about the mode, procedure and outcomes of the interview, the desired control can be effectively exercised over the total operation of the interview.

Such control and effective organisation of the interview then automatically makes it more objective, reliable and valid. The path of the interview becomes totally clear as he has all the material with him (pre-planned, structured and standardised) for the achievement of the interview objectives.

(ii) **Unstructured and Non-standardized Interview.** In this type of interview the interviewer does not either possess the pre-prepared set numbers of questions with him for getting the individual's response nor he has a set of prior decision about the evaluation of their responses in terms of the objectives of the study. The interviewer is totally free to put up any type of questions to the subject for helping him to get the desired information. He may go in any depth for seeking such information. This unstructured, unplanned and non-standardized format of the interview may result in losing

control over the systematic schedule of the interview. The interviewer may put up unnecessary questions after questions for going deep into a single direction, digging out a single aspect of one's knowledge or personality attribute. The subject also may go by elaborating his response and focussing on an irrelevant theme. In this way, this type of interview is regarded as less objective, reliable and valid in comparison to the structured interview. However, it scores a merit point over the structured interview in its characteristic of providing complete freedom to the interviewer and the subject for setting the direction of the interview according to their own perceptions and needs of the situations. The subject gets enough opportunity for his self expression through the spontaneously formed questions of the interviewer and hence there lies greater opportunity for the expression and assessment of the spontaneous behaviour in such type of unstructured interview.

Procedure of Using Interview as Assessment Technique

The application of interview as an instrument of assessment technique is usually carried out through the following systematic steps namely (i) Preparation for the interview (ii) Taking interview and (iii) Closure of the interview.

Let us try to discuss the various activities carried out in these above mentioned steps.

Preparation for the Interview

The following pre-preparation on the part of interviewer may prove quite helpful in the proper application of the interview instrument in carrying out a assessment of the affective domain :

- Be definite about the objectives of the interview and then plan accordingly what is to be asked and observed.
- Try to enlist the co-operation of the students in conducting the interviews.
- Motivate respondents by convincing about the importance of the interview well in advance.
- Get enough knowledge and training about using interview technique for assessing learning outcomes.
- Ensure that physical and psychological conditions in which the interview is to be held should be properly checked so that the respondent interviewer should not feel uncomfortable.
- Ensure that the respondent should feel as natural and spontaneous as possible for providing desired information.

- Have proper arrangement for recording the responses of the respondents.

Taking an Interview

The following essential points should be kept in mind while taking interview.

- Explain the purpose of your interview by being as definite and short as possible.
- Give proper time to the respondent for being ready to be interviewed for your interview questions.
- Ask the questions very carefully but in a spontaneous and informal way surely in the manner and order as planned in your study.
- Don't dominate or monopolies the conversation during the interview. Don't put words unnecessarily into the mouth of the respondent. Be a patient listener and never feel disappointed, imitated or surprised by what the respondent says.
- Use the silent probing technique for getting adequate responses. Just pause and wait. It really works by suggesting to the respondent that you are waiting for his response.
- Encourage the respondent by providing direct encouragement however, in this way that does not imply approval or disapproval of his responses. It may be as simple as saying OK or hunh-hunh.
- Try to get more desired information by asking for elaboration, e.g. Is there anything else you would like to say?
- Ask for the desired clarification of needed by putting questions in some other ways or repeating your questions.
- Demonstrate warmth and respect towards the respondent. Try to have a rapport by winning his confidence and assuring him of the secrecy of his thoughts and feelings.
- Try to accept the responses and reactions of the respondent in its original form and have its record as adequately as possible.

Closure of the Interview

The following things may be kept in mind at this final stage.

- See that the objectives of the interview are realised at the most as decided before holding the interview.
- The information collected should be as complete as possible.

- Try to derive necessary conclusion from the information gathered and responses given by the student for the assessment of the learning outcomes/behavioural changes occurring in their affective domain.

Rating Scales

What is a rating scale ?

Rating scale has a reputation of being a quite popular tool for data collection in the assessment. As a word meaning, it may be referred to a scale that may be used for rating (indicating the worth, value, position, status) the individuals/objects/ideas in relation to their one or other characteristics. In its technical and applied meaning, it has been defined in so many ways by the scholars and researchers in the field of education in the manner given below.

1. **Ban, Davis and Johnson (1953 : 74)** : Rating is a term applied to expression of opinion or judgement regarding some situation, object or character. Opinions are usually expressed on a scale of values. Rating techniques are devices by which such judgements may be quantified.

2. **Britannica on Line Dictionary** : The rating scale is one of the oldest and most versatile of assessment techniques. Rating scales present users with an item and ask them to select from a number of choices. The rating scale is similar in some respects to a multiple choice test, but its options represent degrees of a particular characteristic.

3. **Best and Kahn (2006 : 310)** : The rating scale involves qualitative description of a limited number of aspects of a thing or of traits of a person. The classification may be set up in five to seven categories in such terms as

excellent good average below average poor

4. **Kerlinger (1973)** : A rating scale is a measuring instrument that requires the rater or observer to assign the rated objects categories or continuum that have numerals assigned to them.

A close analysis of the above definitions may help us in knowing about the term rating scale in the manner given below :

- Rating scales are the scales used for rating the objects, persons, events and ideas with respect to their one or the other attributes.
- The term scale is used in our day to day life for measuring physical attributes of the things in quantitative terms such as length, breadth, weight, etc. However, in education it is used primarily for providing

categories or continuum for describing the worth or value of a person, object or idea in relation to their one or more characteristics.

- The description categories used in the rating scale may vary from scale to scale (i.e. 5 to 7 or more) according to the purposes served, the fineness required in the assessment or judgement and the feasibility or flexibility provided by the rating situations.
- The term rating in the field of behavioural assessment stands for providing judgemental or evaluative decisions by others regarding the worth or value of a person, object or idea with respect one or the other characteristics or traits possessed by the rated objects.
- Here the rated objects are those who work as subjects of rating by some body else called the rater or observer who perform this task by closely observing or supervising the tasks or behaviour of the rated objects. For performing his task as a rater, the rater makes use of a scale called rating scale with the help of which he tries to describe the worth or value of the rated objects (with respect to their one or the other characteristics) in degrees or pre-determined categories provided in the rating scales.
- A rating scale may provide qualitative as well as quantitative data in the form of qualitative description and numerals assigned to such description for providing judgemental and evaluative decisions on the part of the raters concerning the quality and characteristics of the rated objects.
- A rating scale essentially consists of three elements namely the rated objects, the rater and the continuum or the yardstick provided for the raters to rate the rated objects in terms of some fixed categories or classifications of the quality or characteristics of the rated objects.

In view of such essentials and typical characteristics of rating scales used in behavioural assessment, we may accept a workable definition of the term rating scale as below :

Rating scale may be defined as a device employed for obtaining evaluative or judgemental opinion from the persons designated as raters or observers about the traits or characteristics of a person, object or phenomena along a well defined continuum in the form of ordered categories (different degrees of quality arranged along a line) accompanied by the respective numerical values assigned to each of these ordered categories.

As example the presentation below is entitled to be labelled as a rating scale for seeking evaluative or judgemental opinion of the class and subject teachers (as raters) about the trait of the punctuality demonstrable in a group of students.

Rating scale for collecting data about the punctuality of the class students

Most punctual	Very much punctual	Punctual	Less punctual	Not punctual at all
5	4	3	2	1

Forms or Types of Rating Scales : In pointing out the various forms and types of rating scales Guilford (1954 : 263) has named the following five scales :

1. Numerical Rating Scales
2. Graphical Rating Scales
3. Standard Rating Scales
4. Rating by cumulative points
5. Forced choice rating scale

As a technique or tool for assessing the learning outcomes of the students however, we may name the first one i.e. Numerical Rating Scales mostly used by the teachers/trainers.

Let us discuss them in detail.

Numerical rating scales

Numerical rating scales as the name suggests provide numerical scores to the rating (evaluative or judgemental opinion) performed by the raters with respect to some traits, characteristics of the rated object. For this purpose, the developer of the rating scale tries to assign some numerals (i.e. numbers through 1 to 5 for the five point scale or 1 to 7 for the seven point scale) for the description of the presence or absence of a particular trait or characteristic in a varying degree (along a continuum) among the rated objects. Thus while asking a group of teachers related to the sports activities of the students to rate the players of hockey team with respect to the traits of leadership (helping in the selection of the captain of the team), they may be equipped with a numerical rating scale given below.

Most suitable	Suitable	Neither suitable nor unsuitable	Unsuitable	Most unsuitable
5	4	3	2	1

While providing instructions to the raters for carrying out the task of rating they may be told that they have to provide their opinion or choice by encircling a particular number indicative of the degree of the suitability or unsuitability of the student for becoming captain of the hockey team.

Such numerical scales may be worded in some other ways for describing the presence or absence of a particular trait or characteristic in a varying degree such as :

Always	Frequently	Sometimes	Rarely	Never
5	4	3	2	1

A teacher/trainer or the peers may now be asked to rate one or the other traits or characteristics belonging to affective behavioural domain of the students such as honesty, sincerity, duty boundness, attitude or interest towards a thing, person, idea or process, cooperation and collaboration, sociability, self-confidence, courage, truthfulness etc.

Guidelines for the construction and use of the Rating Scales

Rating scales as a data collection tool can serve their purpose well only when due care is taken in their proper construction and appropriate use. Here in this connection one should always remember that there are three important components or elements involved in rating *i.e.* the judges who will do the rating, the phenomena to be rated and the continuum along which the rating is to be done. Therefore, all these three factors or elements need to be properly selected and cared for deriving necessary benefits from the use of rating scales. Let us see how can we take care of the proper construction and wise use of rating scales by focussing on the appropriateness or soundness of its three basic constituents.

A. The phenomena to be rated

1. One should be absolutely clear while construction or using a rating scale about the nature of the thing or attribute/phenomena to be rated.
2. The characteristics or traits of the persons, objects, ideas or phenomena to be rated should be well defined for the construction and use of the rating scales. For example, if we want to rate the subjects on the traits of honesty, sincerity or punctuality then we must make clear how their honesty, sincerity and punctuality be assessed or judged on the part of the raters and how in our present study we have defined these terms for the data gathering task.

3. There may be so many characteristics or traits of the rated objects made available for the task of rating. However, here one should be quite wise to select only the most significant ones for meeting the essential purposes of his study.
4. Only one well defined trait or its constituent should be taken at a time for being rated in the constructed rating scale.

B. The continuum of the rating

The continuum along which rating is to be done should be well framed on the part of the scale developers and reasonably grasped on the part of the raters. The things like below may help well in this direction.

1. The quality or characteristic to be judged or rated is provided with certain clues for its rating in terms of the different degrees of quality. The terms excellent, good, poor etc. provided on the rating scale are such clues that help the raters in rating the rated objects according to their assessment about the degree of the characteristic inherent in the rated object. For example, how much punctual or unpunctual a student seems to be for a rater, the cues provided in term of always punctual, seldom punctual, never punctual etc. in the continuum of the rating scale helps him to take a decision for describing the punctuality of the student and therefore, due care should be taken for their proper selection, placement and writing on the continuum of the scale.
2. The meaning of adjective or descriptions used for providing the clues should be quite clear to the rater. For example, the adjective "seldom punctual" needs to be defined and made clear to the raters for the proper execution of their task of rating. In this regard, it is always better to seek judgement and agreement of several judges regarding the meaning of adjectives and descriptions to be used.
3. A rating scale may have a number of divisions, steps or points for naming it as a three point, five point, seven point, nine or eleven point scale depending upon the degree of precision or fineness of the rating needed by the researcher in his study. Usually 5 or 7 points rating scales are quite popular. While the smaller number of divisions like three may put a hurdle in seeking more or fine discrimination, the larger numbers like 9 and 11 may confuse the raters for carrying out their task properly.
4. It is advisable to change the ends of the scale so that the 'good' end is not always at the top or always at the bottom of the scale.

3. The words such as 'average' inserted in the middle of the scale should be avoided as far as possible on account of the fact that they may become solitary option for the raters who do not want to take pains in the rating work.

C. The Judges who will do the rating

The success in the use of the rating scale as a data gathering device depends much on the right selection of the judges for performing their duties as sincerely and honestly as possible. For this purpose, it is advisable to take care of the following things on the part of the researchers.

1. One should be quite wise and choosy in assigning the task of rating to the raters. As far as possible, these raters or judges should be quite experienced and expert in the subject area of the education besides being familiar with the persons, objects or situations to be rated.
2. In giving directions to the raters in his rating scale a evaluator should invariably insist and indicate the need for remaining sincere and honest in the task of rating. He should also provide a hint directly or indirectly that a low rating will not have any consequence for the object under rating.
3. The raters should be given a proper assurance that their anonymity will be safe guarded.
4. For keeping desirable reliability on the results of rating it is advisable to employ several judges or raters and then needed information may be gathered through proper analysis of the pooled ratings.

By taking care of the above discussed things, thus a teacher can prepare and administer a rating scale for the evaluation or assessment related to one or the other behavioural domains of the students.

Questionnaire

Questionnaire as a tool for collecting information or data for assessing learning and behaviour of the children has been defined variously by the Scholars in the manners given below :

1. Goode and Hatt (1952 : 133) : "In general, the word questionnaire refers to a device for securing answers to questions by using a form which the respondent fills in himself."
2. Ban, Davis and Johnson (1953 : 65) : "A systematic compilation of questions that are submitted to a sampling of population."

3. Young, P.V. (1965 : 177) : The questionnaire is defined as a form used in self-enumeration, usually mailed to the respondent In which the content is aimed at finding out facts or opinions or both

4. Best and Kahn (2006 : 312) : A questionnaire represents "the general category of inquiry form including data gathering instrument through which respondents answer questions or responds to statements in writing. A questionnaire is used when factual information is desired. When opinion rather than facts are desired, an opinionnaire or attitude scale is used. Of course, these two purposes can be combined into one form that is usually referred to as a questionnaire."

All these above mentioned definitions of the term questionnaires, if analysed in a proper way may help us to derive a meaningful portrait of the term questionnaire as a research tool in the way mentioned below.

Questionnaire, in general, is referred to a device or tool consisting of some systematically planned questions in the shape of a form which the respondents fill in themselves for providing answers to the questions asked. In this way, questionnaires are usually paper and pencil tools (forms) that are filled up by the respondents of a given population or the representative sample of the study for providing desired information or data (both quantitative and qualitative) as needed by the researchers in their action research projects.

Questionnaire is a quite popular tool for obtaining information or collecting necessary data for any type of assessment or evaluation in education. It is either administered personally to an individual/group of individuals or mailed in case the respondents are lying at a distance.

Question Format

The choice of a particular format of the questionnaire is based upon (i) the type of information needed from the respondents for meeting the research objectives in a particular situation at a particular time and (ii) the way of analyzing the collected data. Generally, two types of questions (closed and open-ended) are usually employed in the questionnaires for seeking structured or unstructured responses from the respondents.

(a) **Closed questions format** : With the help of the questions belonging to this format of the questionnaire, the researcher is able to gather structured responses from the respondents. Usually the following two types of questions are used for getting structured responses from the respondents.

Dichotomous or Forced Choice Questions : Here the respondents are provided two alternatives for putting up their responses. He is to make his choice compulsorily out of these two, by encircling, writing or putting

✓ and ✗ marks against the space provided for this purpose.
In your opinion who is to be blamed more for encouraging dowry evils in the society? Men/Women

Multiple choice questions : Here the respondent is required to provide his response or indicate the degree of his agreement or disagreement with the given item out of the given multiple choices by encircling his choice.

Example

How would you rate the overall performance of a particular student in the project activities performed in your group?

Very Good

Good

Average

Poor

Very Poor

(b) Open ended Questions Format : In such format of a questionnaire, the questions used do not impose any constraint or require any forced or structured responses on the part of the respondents. There is a complete freedom provided to the respondents to structure their responses and use words of their own choice in phrasing a reply. Here no clues (like in the closed questions) are provided for the respondents to respond. They are free to respond and thus their responses may reveal many things not otherwise revealed through the structured format closed questions. However, the responses to such questions are somewhat difficult to interpret, tabulate and summarize in a proper way. In its actual working in such type of format, questions are so framed as to demand the writing down of the text in the form of the responses of the asked questions. These can vary from short comment boxes to the lengthy space provided for detailed comments.

Examples

1. Please, give your suggestions for controlling noise pollution in your city.
2. The most striking causes for the water pollution in the rivers from my angle are
 - (i)
 - (ii)
 - (iii)

Wording of the Questions

In a questionnaire, each question has its value in matter of deriving the desired factual information or opinion of the respondents regarding the

issue raised. The wording or phrasing of these questions in a proper way, thus matters much for serving the required objective of the utilization of the questionnaire as a research tool. In doing so, the things like below should be kept in mind by the questionnaire developers

1. Objectives of the study : The objectives of the information gathered should always be kept in view while framing the items of the questionnaire. Each question and its language should specifically serve the purpose of collecting data.

2. Simplicity and clarity : Questions and statements used in a questionnaire need to employ the necessary simplicity and clarity in its wording by keeping in mind the necessary things like below.

(i) The educational level and language of the respondents : In framing questions, one should always keep in mind the educational level and language of the respondents so that they may not face any difficulty in grasping and responding to the questions.

(ii) Use of complete sentences instead of fragments : The questions or statements used in the questionnaire should consists of the complete sentences, not fragments as illustrated below :

Fragment

Age.....

Annual Income of your parents in rupees.....

Complete sentences

What is your age ?

What is the annual income of your parents ?

(iii) Avoiding mis-interpretation of the terms or language used : In wording the questions of a questionnaire due care should always be taken for the clear understanding and interpretation of the meaning of the terms and language used in the questions. One should be always cautious to avoid misinterpretations of the terms or language used in the questions

Characteristics of a Good Questionnaire

1. A good questionnaire deals with a significant topic, one the respondent will recognize as important enough to warrant spending one's time on. The significance should be clearly and carefully stated on the questionnaire.
2. It only seeks information that cannot be obtained from other sources such as school reports or census data.
3. It is as short as possible and only long enough to get the essential data. Long questionnaires frequently find their way into the waste-basket. Keep the writing required of the respondents to a minimum and make the response system clear and easy to complete.

4. It is attractive in appearance, neatly arranged, and clearly duplicated or printed.
5. Directions for a good questionnaire are clear and complete. Important terms are defined. Each question deals with a single idea and is worded as simply and clearly as possible. Avoid asking two questions in one. The categories provide an opportunity for easy, accurate, and unambiguous responses.
6. The questions are objective with no leading suggestions as to the responses desired. Leading questions are just as inappropriate on a questionnaire as they are in a court of law.
7. Questions are presented in good psychological order, proceeding from general to more specific responses. This order helps respondents to organize their own thinking so that their answers are logical and objective. It may be well to present questions that create a favourable attitude before proceeding to those that may be a bit delicate or intimate. If possible, avoid annoying or embarrassing questions. When questions of a delicate nature are necessary, the questionnaire should be anonymous.

Administration of the Questionnaire

The questionnaire developed by the researcher can serve its purpose of collecting needed information or data related to the study only when it is administered rightly to the subjects of the study. There are two different procedures that are usually adopted for the administration of the questionnaire to the desired sample of the research study *i.e.* to administer in the group of respondents through face to face contact and to administer the questionnaire through mail. Let us know about these one by one.

Group Administration : In such type of administration, a group of respondents (the desired sample of the study) is brought together for responding to the questionnaire instrument. The researcher may himself work as an administrator of the questionnaire to the assembling group of the respondents. He may properly address them for making his purpose clear and motivating them to respond to the each and every item of the given questionnaire. If respondents feel unclear about the meaning of a question, they are free to seek clarification from the researcher. The researcher in such face to face administration situation may be able to secure almost cent percent responses to the items included in the questionnaire.

Administration through Mail : In such type of administration, questionnaire is sent to the intended group of respondents through a suitable mail service. The respondents also in turn are expected to send the filled in

questionnaire by the post within the stipulated time limit mentioned the forwarding letter sent to them with the questionnaire. There are many advantages to mail administration over the group administration in person. They are relatively inexpensive to administer. The researcher can send the exact same instrument to a wider number of people for collecting data for his study. Their administration through mail allows the respondents to fill them at their own convenience. However, there are some disadvantages.

Analysis and Interpretation of Questionnaire responses

After receiving the responses from the respondents, the next task is to have a proper analysis of the collected information for deriving useful meaning of them. For such analysis beginning is to be made through the proper tabulation and organization, of the collected data. It can then be subjected to some useful statistical procedure such as finding out central tendency, variability of the scores, correlation, chi-square statistics etc. according to the needs of the study. Apart from such quantitative analysis of data, qualitative analysis can also be performed through the needed analysis methods. Such analysis may then be successfully used for interpreting the collected information to meet the set objectives.

Checklist

Checklist in its simple meaning stands for a list that can be used by an observer at the time of checking the presence or absence of the items included in the list. Many times a checklist is thus referred to as a simple laundry-list type of assessment device. While giving items to a laundry man, housewives prepares a list of items and take the help of this list in assessing the presence or absence of any item from the list at the time of taking delivery from the laundry man. Similarly what type of characteristics in the product (the outcomes of the learning of the students) should be there for grading it in one or the other ways, the listing of these characteristics constitutes the items of a checklist used for the evaluation of the students products. The teacher/evaluation simply put a right or wrong (yes/no) marks against the listed items for getting it evaluated. In this way checklist represent a quite handy tool at the hands of the teacher/evaluator for evaluating or assessing the presence or absence of the attributes listed for taking judgement about the product or behaviour demonstrated by a student at the time of observation/checking.

Checklists can also be used like a questionnaire to be checked or responded at the hands of the students under assessment. Whether it is filled in or checked out by the observer/teacher or students (under assessment), the task requires to record the presence or absence of the phenomena or

attributes under study. Responses to the checklist item are thus a matter of fact, not, of judgement. One checks out or records the facts in responding to the checklist rather than saying anything from his/her side.

Format for Checklist

The popular format used for checklist may be exemplified as below :

1. Check list for the Assessment of Affective Domain (Morality)

Make a check mark (✓) in the blank against each traits visible in the behaviour of the students

Honesty	()
Punctuality	()
Truthfulness	()
Duty boundness	()
Self confidence	()

2. Check list for the Assessment of learning outcomes in

Mathematics

Make a check mark (✓) in the blank against learning of each skill.

Digit Recognition	()
Numeration (Reading of Numbers)	()
Counting	()
Writing of Numbers	()
Problem Solving	()

Analysis and Interpretation of Checklist Data

It can be done in the manner given below :

- Tabulate and quantify the check-list data in the way as done in the case of questionnaire data. Count the frequency and calculate percentages and averages.
- Graphical representation mode may also be used for the needed explanation and comparison.
- Computation of measures of central tendency, mean, median and mode can be carried out.
- In the case of long check list (where related items are grouped together) it remains useful to add up the checks for providing total scores for the categories under assessment.

Cumulative Record

Cumulative record, as the name suggests, represents a total and comprehensive permanent and confidential record of the cumulated

educational growth and all round development of the individual student starting from the beginning of his educational career till the present stage. It is infact a complete history and pen picture of the journey travelled by an individual student with respect to his educational attainments and growth and development of his personality along with some necessary information about his family and home back ground.

Maintenance of cumulative records of the students in school proves a big helping hand in the task of welfare and progress of the students.

Emphasizing the need of their maintenance secondary education commission (1952-53) has commented in the following words.

"Neither the external examination nor the internal examination singly or together, can give a complete and correct picture of pupil's all round progress at any particular stage of his education, yet it is important for us to assess this in order to determine his future course of study or future vocation. For this purpose a proper system of school records should be maintained for every pupil indicating the work done by him in the school from day-to-day, month to month, term to term and year to year. Such school records will present a clear and continuous statement of the attainment of the child in different intellectual pursuits throughout the successive stages of his education."

Through the above lines in this way, secondary education commission has emphasized to maintain the educational history of the individual students. However here it has only stressed upon developing his history in terms of his attainment in different intellectual pursuits. This dimension needs to be extended to the attainments in other fields, physical, social, emotional and ethical accounting for the complete all round development brought in the personality of the student through the process of education. Then and then only we can know what the student is in himself.

What type of cumulated information or data is preserved and maintained by a school through cumulative record may be made clear through a sample of the formats used for the collection and recording of such data. Let us here try to present if for the purpose of illustration and application.

A Specimen Format of the Cumulative Record Card

A. Identification Data

1. Name of the pupil -
2. Name of the Father/Mother/Guardian -
3. Date of Birth -

B. School History

Name of the School	Date & Month of Admission	Class of Admission	Date and year, cause of Leaving School	Remarks If any

C. Family & Home Background

- (1) Education of parents/guardian
- (2) Type of family - joint or unitary
- (3) Number of members in the family
- (4) Position of the child in the family
- (5) Economic status of the family
- (6) Religion of the family
- (7) Ambitions of the Parent's about the child
- (8) Any other important Information

D. School Attendance

Year	Total Attendance	Attendance of the student	Cause of Absence
2008-09			
2009-10			
2010-11			

E. Physical/Medical Report

Year	Height	Weight	Chest		Eye sight	Any Disease	Other Remarks
			Expel.	Condrd.			
2008-09							
2009-10							
2010-11							

F. Scholastic Achievements

Subjects	Class VI		Class VII		Class VIII	
	Year 2006-07		Year 2007-08		Year 2008-09	
	Half yearly	Annual	Half yearly	Annual	Half yearly	Annual
English						
Hindi/Punjabi						
Sanskrit						
Mathematics						
Science						
Social Studies						
Physical Edu.						
Art & craft						
Agriculture						
Other subjects						
—						
Total						
Position in the class						
No. of students in the class						

G. Performance in Co-curricular Activities

Activities	Average grade of the child for each performance throughout the year		
	Class - year -	Class - year -	Class - year -
Sports and games			
Cultural Activities			
Literary Activities			
Social Service			
Personal Hygiene			
Other Activities			
Remarks			

H. Personality traits (Average grade for each performance through out the year)

Traits	Class – year –	Class – year –	Class – year –
Initiative			
Leadership			
Truthfulness			
Honesty			
Courtesy			
Co-operativeness			
Self confidence			
Emotional stability			
Sociability			
Obedience			
Regularity			
Punctuality			
Reliability			
Any other Trait			

I. General Remarks

Particular	Class – year –	Class – year –	Class – year –
Status of the student in fulfilling the responsibility			
Special Honour (if any)			
Signature of the class teacher			
Signature of the Head-master or Principal			

Characteristics of a Good Tool of Evaluation

Evaluation is a quite essential element or component of the teaching learning process or the education system in general. It can help well in serving the interests and ends of learners, teachers, parents, school administrators, educational planners, employers and others associated with the processes and products of education. However, for serving its purposes well a system or tool of the measurement and evaluation must meet the criteria of a good or ideal evaluation characterized as below:

1. Validity. Validity refers to the accuracy in behaviour. If a watch show quit accuracy in telling the time as it always tallies with the standard time shown on the television channel or told by a radio channel then it can be termed as the valid one in terms of serving its function. Similarly a tool of evaluation may be termed as a valid tool if it is able to demonstrate accuracy in its functioning or behaviour. In other words, it should evaluate or measure what it seeks to measure.

For example a tool of evaluation meant for measuring or evaluating the teaching-learning outcomes in the subject mathematics should measure or evaluate the performance or achievement related to the subject mathematics instead of one's proficiency, knowledge and understanding related to language or art.

2. Reliability. Reliability refers to a faith that can be put into the working and functioning of an object or phenomenon. Accordingly a watch can be termed reliable if it can be relied on account of the consistency demonstrated by it in its behaviour even if it does not meet the criteria of validity i.e. always telling accurate time. (It may show consistency by remaining late by five minutes or going fast by five minutes in 24 hours). In the similar way a tool of evaluation may be said to be a reliable one if it evaluates or passes judgement over the performance or achievement of the learner in almost the same way i.e. providing the same numerical scores everytime. However, in case an evaluator assigns 60 marks out of 100 in a given test to an examinee and the same examinee gets 40-45 marks out of 100 if his answer book (the similar-one evaluated by the first examiner) are evaluated by the second examiner, then the test or evaluation tool can not be termed as a reliable one.

3. Objectivity. The evaluation is said to be objective if responding to the test items on the part of the examinees or marking of the responses by the evaluators is not at all affected by their respective personal interests, attitudes, feelings and whims. In other words, subjectivity inherent or shown by the examinees and evaluation on their part in terms fulfilling their duties as examinee and evaluator does not affect the evaluation outcomes in a tool termed as objective. In this respect when the essay type examinations are loaded with extreme subjectivity on the part of examinees and evaluation, the objective type carries sufficient objectivity on account of having a single straight forward response for the items included in them. e.g. an item like who is responsible for the down fall of mugal empire? May be coloured widely with the interests, attitudes, fund of knowledge, feelings and whims of both the examinees and evaluators. However an item like "Aurangzed is most often blamed for the down fall of..... empire", may be termed as sufficiently objective.

4. **Comprehensiveness.** Comprehensiveness of a test or evaluation tool is known or estimated through the length of the test or the amount of its coverage of the assessment of the learning outcomes or achievements of the students. Accordingly a test or evaluation tool may be said to be quite comprehensive, if it demonstrates its capability of measuring or assessing the teaching-learning outcomes related with each and every aspect of the content material, topic or units of the subject covered through the classroom teaching-learning. In this way, a test or evaluation for being equipped with the characteristic of comprehensiveness need to have large number of questions for providing representation to the evaluation of what has been expected from the learners in terms of the teaching-learning outcomes. In this connection where essay type examinations may have less or no scope for demonstrating the quality of comprehensiveness, the test including short answer type or objective ones may demonstrate sufficient characteristics of comprehensiveness by including large number of questions and providing coverage to the wide area of contents and topics covered in a particular session.

5. **Diagnosticity.** A good evaluation tool is characterized with the quality of being diagnostic in nature. We know that a proper diagnosis is always needed for providing a proper cure or treatment to an ailment or disease. The same is true with the students suffering from the learning difficulties, inefficiency and failures. We must have a proper diagnosis of their difficulties and weaknesses related to their learning areas or behavioural dimensions for getting rid of them with their deficiencies and problems. Accordingly a system or tool of evaluation must invariably help in supplying information related to such diagnosis.

6. **Practicability.** A good evaluation tool or test must be equipped with the features associated with the needed convenience and practicability of its construction and use in the manner given below:

(a) **Ease in preparation.** The evaluation tool or test should be quite convenient and economical in terms of labour, time and expenditure for its preparation and construction at the hands of the paper setters or tool developers.

(b) **Ease in Administration.** The evaluation tool or test should not pose unnecessary inconvenience or problems at the time of its administration i.e. taking examination or testing the students. More particularly, it should not pose the problems related to copying, talking or consulting with each other or temptation of knowing answer by hook and crook etc.

(c) **Ease in scoring.** The evaluation tool or test should not pose difficulties or problems to the evaluators in evaluating the responses of the examinees. We can understand very well that the evaluation of the responses of the essay type questions may prove a big headache for the evaluators as

it becomes difficult for providing fair and objective treatment for the lengthy responses of the wide variety of the examinees. On the other hand, the short answer or objective type questions may prove quite handy and convenient to them for their single and straight forward responses.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. Name the different tools and techniques employed for the evaluation or assessment of learning outcomes or performance of the students and discuss any one of them in detail.
2. Discuss observation as a tool or technique of assessing the learning outcomes or performance of the students.
3. Discuss the use of interview as a tool for assessing the learning outcomes performances of the students.
4. What is a rating scale? How can it be used as a tool for assessing the learning outcomes or performances of the students? Discuss in detail.
5. What is a cumulative record? How can a cumulative record be helpful as a tool for the assessment of the students? Discuss.
6. What is a questionnaire? Discuss its format, and administration for collecting data regarding the assessment of the students.
7. Discuss in detail various characteristics of a good assessment tool.

B. SHORT ANSWER TYPE QUESTIONS

1. Name five important tools and techniques commonly used for assessing the learning outcomes or performances of the students.
2. What is observation/rating scale/questionnaire/interview/checklist as an assessment tool.
3. Name the type of observation made into use for assessing students.
4. What is structured/unstructured/participant/Non-participant observation?
5. What is structured/unstructured interview?
6. What is a numerical rating scale?
7. What is a closed question or open question format of a questionnaire?
8. Give an example of the use of checklist employed for the assessment of the performance of the students in a given area.
9. What is a cumulative record?
10. Name the various characteristics of a good assessment tool.

Self-Assessment and Feedback

Chapter Outline

- What is Feedback ?
- Purposes and Functions of Feedback
- Types of Feedback
- Which type of Feedback should be employed ?
- Role of Feedback in Improving Learning
- Self-assessment and Feedback
- Study Questions

What is Feedback ?

Dictionary of Education (C.V. Good, 1939) defines feedback as "a process whereby an observer reports to a group on how well it is functioning." Consequently, the term feedback stands for a sort of mechanism or device to provide information to an individual or group of individuals about its behaviour or performance in order to modify it in a desirable way. This information help in knowing the strengths and weaknesses related to the working of an individual, group of individuals, system or a machine. On obtaining such information about one's working one can try to bring desirable improvement and modification in one's system of working.

This definition explains the role of feedback in any process or working system. A system is put to order by putting some material or energy in it as input. After processing, this input must yield and result into the planned products called output. The system operator should have a timely knowledge and information of the outcomes and outputs of a system so that he can modify or change the contents of the input and also the methods of processing it for having effective output. He gets this knowledge and information from the contents of output and the acquisition of such knowledge and information through the contents of the output is known by the term feed-back. It feeds

the system itself, if it is a self operating, self-regulating and self-controlled system or the system operator for knowing about strength and weaknesses of the input or processing of his system in order to modify the system for the better results

Understood in this way, feedback refers to a device, process or mechanism with the help of which an individual or a system receives information about its working in term of its strength and weakness in order to bring desirable improvement in its working. In case a learner receives proper feedback about his learning performance he may bring desirable improvement in the contents and methods of his learning. If a teacher receives feedback i.e. information about the quality of his teaching he may set himself for bringing desired modification in his teaching behaviour in the light of such feedback. In case a machine or self operating system receives information about its working it may regulate and control its mechanism in view of this information i.e. feedback received by it. In this Way, feedback by providing information about the working of an individual or a system through the evaluation of the products and outcomes of the efforts may prove a boon to an individual or a system for bringing desirable improvement in its functioning or working. A learner can learn well, a teacher can teach well, an administration set up, an educational system or instructional plan and strategy can work well with the help of an appropriate feedback mechanism simply because it is able to receive timely and appropriate knowledge of the strength and weaknesses of its working.

Purposes and Function of Feedback

Feedback as explained above aims to provide information about the functioning or working of an individual or a system. It serves the following two broad purposes or function in the learning and development of the students.

(A) Controlling Function : Feedback provides a proper mechanism for exercising control over the functioning and working of an individual or a system. The controlling functions of the feedback mechanism can be explained and illustrated in the following ways :

- An individual behaves in a particular way. The outcomes or impact of his behavior upon the persons or environment provides feedback to him to exercise control over his behavior and style of interaction.
- A learner aims to achieve certain objectives through his learning. He adopts particular ways of learning and time to time evaluates his learning outcomes in the light of the realization of the set objectives. Such evaluation helps him to provide feedback for exercising control

over his learning behavior. In the light of such feedback he is helped in bringing changes in the contents of the learning experiences, learning methods and learning environment, etc.

(B) Reinforcement Functions : The feedback mechanism is said to provide reinforcement to the on going behaviour and functioning of an individual or a system.

Reinforcement is usually defined as something which can create conditions or situations for strengthening the existing or on going behaviour of an individual or system. The feedback mechanism, by its very nature is quite capable of providing proper reinforcement to an individual or a system simply because it provides proper information about one's level of performance as may be evident from [he following illustration.

- A child behaves in a particular way. In consequence, he is admired, blamed or attended in any way. the output of his behaviour thus provides sufficient feedback for reinforcing his behaviour. He knows well that by behaving in this particular way he is able to catch the attention or get admiration from whom he needs it. This knowledge or feedback helps him to get due reinforcement for continuing his present behaviour with more zeal and enthusiasm.
- A learner while proceeding on a learning path gets immediate knowledge of his results and progress. Such type of feedback is quite capable of reinforcing his learning behaviour and as a result he may get due encouragement and incentive for the proper strengthening of his learning behaviour in the achievement of the desired learning objectives.

Types of Feedback

Feedback as a controlling and reinforcing mechanism may take many shapes and styles depending upon its sources, and the time as well as mode of providing such feedback. Usually it may be classified or distinguished in the following two broad ways.

A. Classification based on the sources of feedback : According to this criteria feedback may be classified as

- (i) self-feedback
- (ii) Feedback provided by others and
- (iii) Mechanical feedback.

Self or auto feedback is that feedback which is provided by the individual or the system itself for self correction and improvement. In a cybernetic system such type of feedback is provided by the system itself.

An individual learner, worker or teacher may also try to improve his performance through a close introspection of his performance in the light of the results of some evaluation programme by comparing it with some model or ideal performance.

The second type of feedback is provided by the persons other than self like peers, colleagues, co-workers or pupils, teachers and supervisors etc. In this type of feedback when one learns, teaches or works, his performance or behaviour is observed by others. These are reactions or responses on the part of the observers which may work as a source of feedback or the merits and limitation of one's performance may be explicitly told to him by the observers in the form of the comments and suggestions.

The last type of feedback is carried out through some mechanical means like video and audio tapes, teaching machine and computers etc.

B. Classification based on the mode of providing feedback : According to this basis feedback may be classified as

- (i) Positive feedback
- (ii) Negative feedback and
- (iii) Mixed feedback.

Positive feedback is that feedback with the help of which attempts are made to inform a learner, teacher or worker about the strengths and good points of his performance. Contrary to this in negative feedback attempts are made to inform him about the short comings and limitations in his performance. On the other hand, the mixed feedback involves the mixed responses carrying positive as well as negative point about one's performance.

C. Classification based on the time and schedule of feedback : According to this basis, feedback may be classified as

- (i) immediate feedback and
- (ii) delayed feedback.

Immediate feedback is that feedback which is provided to a learner teacher or worker during the very performance of his behaviour or immediately after his performance. However, in case there remains a gap between the occurrence of these two activities—performance and the feedback, we call this feedback as delayed feedback.

Which Type of Feedback Should be Employed ?

In exercising desirable control over one's functioning or reinforcing and improving his performance which type of feedback should be provided is a critical question that needs attention at this stage. The varying modes

and styles of feedback suggested above have their own functions and utility depending upon the situations and circumstances and the purposes served through this feedback.

As far as the utilisation of the sources for providing feedback is concerned, it is better to utilise and involve as much sources as possible for the possible appropriate feedback. A behaviour or performance may get controlled, reinforced, modified and improved if it can be properly supplemented and reinforced through various modes of feedback provided through varying sources like self, others and mechanical means. For example a student teacher can be very well assisted in the process of modifying his teaching behaviour through self-evaluation, observation and supervision by others and the feedback supplied through mechanical means like tape and video recording etc.

In the case of selection among positive, negative and mixed type of feedback it is always better to employ the mixed type of feedback for getting more- fruitful results in - the task of improving one's performance. It is true that positive feedback will prove more suitable for reinforcing one's behaviour in comparison to the negative feedback. However, it is more appropriate to take a balanced stand by pointing out strengths and weaknesses of one's performance so that he may be helped in exercising desirable control and take suitable measures for bringing correction and improvement in his behaviour.

In the case of choice between immediate and delayed feedback it is always better to choose the former. We must remember it is the immediate knowledge of one's results and progress that proves a constant source of reinforcement and motivation for keeping him steady and alert on the path of his performance. Delayed feedback loses its significance and charm. Therefore, it is always better to provide the doses of feedback to a learner, teacher or worker well much, during the timing of his performance or just after the occurrence of the behaviour that is aimed to be controlled, reinforced, modified or improved.

Role of Feedback In Improving Learning

Learning as we know is always directed to attain some aims or realize some purposes. Time to time assessment or evaluation of the progress in learning carries both the controlling and reinforcement functions for bringing desirable modification and improvement in the process and product of learning. Let us first take the help of the controlling function of the mechanism of feedback in improving students' learning.

(i) **Feedback helps in improving learning through its controlling function** : Evaluation or assessment as we know is known as the controlling key of a teaching-learning process carried out for the realization of some well thought teaching-learning objectives. After travelling some journey on the learning path, the knowledge of the progress (through one or the other evaluation measure) may help the learner as well as teacher for getting acquainted with the processes and product of their teaching and learning outcomes. It tells or provides them necessary feedback about the satisfactory/unsatisfactory progress of their teaching-learning efforts. In the light of such feedback then necessary steps are taken for exercising desirable control over the ongoing teaching-learning process e.g. bringing alteration/modification in the teacher-learning or instructional objectives, content material or learning experiences, methods of teaching-learning, teaching-learning environment, interaction and activities etc. Renewed efforts are then made for the teaching-learning of the students. The progress on this account is again assessed for providing further feedback about the appropriateness or inappropriateness of the ongoing teaching-learning process in the realization of the set teaching-learning objectives. If need so again necessary correction/modification in the teaching-learning system may be made or it may be allowed to proceed in its present form. In this way, feedback received through the timely evaluation/assessment of the learning outcomes of the students may help the teacher and learner in exercising desirable control over their teaching-learning efforts and the control so exercised, no doubt helps much in bringing necessary improvement in the learning of the students.

(ii) **Feedback helps in improving learning through its reinforcement function** : Learner is very much helped in bringing desirable improvement in his learning by a proper reinforcement schedule made available to him through a system of timely feedback. In the Skinner's learning experiment carried out with rats, the rats were able to proceed well on their journey in a maze with a proper feedback available through the availability or non-availability of electric shock or jerks. Similarly when the progress of the learner on the learning track is reinforced well (either through the immediate knowledge of the results or progress or by a teacher/instructor through his encouraging gestures/words) then it surely helps him to demonstrate encouraging improvement in the process and product of his learning. When a trainer provides the trainee timely feedback about his progress in learning or performing a skill or task, it helps in reinforcing his learning behaviour in a suitable way. While positive reinforcement secured through a feedback mechanism (often in the form of information about his

progress in learning) helps the learner in continuing his learning activities in a more forceful way, the negative reinforcement or warning available to him helps him to bring needed modification in his learning styles/methods resulting in the improvement of his learning.

Self-assessment and Feedback

Assessment of any sort carried out in one or the other teaching-learning situation furnishes valuable information or data providing appropriate feedback for the benefit of learners. It is also true for the self-assessment, i.e. the assessment of one's own capacities and abilities, strength and limitations, potential and worth, learning and performance etc. It also helps the learners in getting needed feedback for their mid-way corrections on the learning and developmental paths and seek necessary motivation and direction for going ahead on the path of their progress and development. Let us see how the measures involving self-assessment may help the students in deriving useful feedback for their progress and development.

Situation 1. In language laboratory students may be seen to get engaged in various type of language skills. Here, they may also get opportunity for having the self-assessment of their learning with the help of the comparison they make between the model skill and skill they demonstrate during their practice or evaluation session. How do they pronounce and converse in a particular language and how far they are right in doing so can be properly revealed to him through their self-assessment. Such type of timely feedback available to them may help them in learning and improving the needed language skills, abilities and capacities pertaining to speaking listening and communicating properly in one or the other languages.

Situation 2. A student gets training in gymnastic or doing yogic exercises. He records the right way of doing these acts. Now he can get engaged in doing practice for his learning. In doing so he may have the self-assessment of his learning outcomes by comparing the video recording of what was taught to him and what is being performed now by him.

The feedback received by him about the nature and quality of his performance through his self-evaluation now can prove quite beneficial for him in deriving useful incentive or midway correction and improvement in his practice schedule, ways of doing the exercises etc. Players and athletes derive useful benefits for getting feedback through an appropriate self assessment of their attempts, progress and success in the trial and practice period. With stop watch, time keeper, video recording and other sophisticated available electronic gadgets it is now properly possible for them to get reliable and rated feedback through their self evaluation.

Self-Assessment and Feedback

Situation 3. In the formal class-room set up also the students may get a lot of help from the feedback received by them through their self-evaluation. For example when they are solving practice problems related to physics, mathematics, economic, commerce, chemistry etc. and evaluating their outcomes with the help of answers given in the text or question bank appendix made available to them for this purpose, the feedback received in such a way may help them a lot in getting acquainted with the nature of their progress and seek appropriate remedial instruction with the help of teacher or peers.

Situation 4. The learning of various skills in scholastic areas (i.e. laboratory practical and project work skills in sciences including home science, social sciences) and non-scholastic areas (i.e. music, dance, debate, drama, arts and painting) life saving, social and emotional skills etc.) may be very much facilitated and improved as a result of feedback received through self evaluation or assessment. One can have audio-video reading of his performance and compare it with the model or norms available to him for performing these activities. In a simple or normal way, one remains totally conscious of the level of his performance and such consciousness may provide him needed feedback for the renewed attempts and struggling towards success.

Situation 5. The availability of properly developed rubrics may also help the students in the self-assessment of their learning and performance. In a rubric attempts are made to state and clarify that what type of performance of the student will earn what type of grading. The qualities or characteristic of a behaviour or performance here are clearly stated for making easy for a learner to keep him in the higher or lower category of achievement potential. The students with the help of well developed specific rubrics thus can have appropriate self-assessment of the learned behaviour belonging to their cognitive affective and psychomotor domains. The results arrived at through the using these rubrics may help the students well in getting proper feedback for improving their performances and levels of achievement.

In this way the fruits in the form of timely feedback available through the self assessment of their own learning outcomes or performances on the part of students may help them much in their proper learning and progress related to scholastic as well non-scholastic areas. In a teaching-learning process then a wise teacher should never forget to make use of such important mechanism for helping his students in their desirable learning and development.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. What is feedback ? Discuss its purposes and functions.
2. What do you understand by a feedback mechanism ? Discuss the various types of feedback and tell which type of feedback may be adjudged appropriate in our classroom situations.
3. What is feedback ? Discuss the role of feedback in improving learning.
4. What is self assessment ? How does it help in providing necessary feedback for bringing improvement in the progress of students learning and performances ? Explain with examples.

B. SHORT ANSWER QUESTIONS

1. What is feedback ?
2. Tell any two things concerning controlling and reinforcement functions of feedback.
3. Classify feedback according to their sources/according to the mode of providing feedback/according to time and schedule of feedback.
4. Distinguish between immediate and delayed feedback/negative and positive feedback.
5. Provide an example for illustrating the role of feedback in improving learning.
6. What is self-assessment ?
7. How does self-assessment provide needed feedback in improving learner's performances ? Tell with the help of an example.

6

Achievement Tests

CHAPTER OUTLINE

- What are Achievement Tests ?
- Types of Achievement Tests
 - Standardized tests
 - Teacher made tests (oral, practical and written)
 - Subjective (Essay Type) and Objective Type Tests
- Construction of an Achievement Test
- Study Questions

What are Achievement test ?

Achievement tests are used for testing or measuring the achievements and success of an individual or group of individual in a particular field or area of the life activities. In school situations these are used to test or measure student's learning in a particular subject or a group of subjects. How far a particular student has been able to learn and acquire or has been benefited from the learning experiences given to him is ascertained with the help of these tests. Therefore, achievement tests are essentially past-oriented. They give evidences of what has been learned or acquired by an individual by testing his present ability. Knowing all these facts, if we are required to define an achievement test, we can define it in the following words :

An achievement test is essentially a tool or device of measurement that helps in ascertaining quantity and quality of learning attained in a subject of study or group of subjects after a period of instruction by measuring the present ability of the individual concerned.

Types of achievement Tests

Diagrammatically we can represent the types of achievement tests as below :

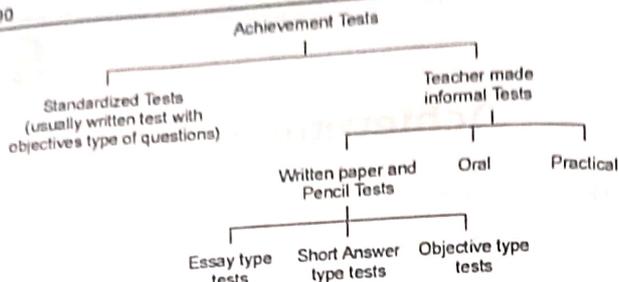


Figure 6.1 Types of Achievement Tests

Standardized Tests

Standardized as the name suggests are those tests which are quite formal and standardized. These are found to be based on a systematic and scientific research methodology and are usually objective type. Clarifying the concept of a standardized test, Lee J. Cronbach (1970) writes.

"A standardized test is one in which the procedure, apparatus and scoring have been fixed so that precisely the same test can be given at different times and places."

In this way the chief value of standardized tests is centred around their characteristic of being standardized i.e. fixation in terms of the processes and product. Let us see what is being standardized or fixed in standardized test for providing it an uniqueness in the manner given below.

- Number and shape of the items used in the test is fixed for testing the achievement of the students of a given population.
- The population for which test can be used is fixed since standardization of the test is always done on a representative sample from the well defined population.
- The instructions for administration of the test are quite fixed or standardized.
- The duration of the test is also fixed. Every student appearing in the test is given that fixed duration for answering all the items of the test.
- The test has objective type items on account of their objective i.e. standardized nature of maintaining high degree of reliability, validity, objectivity, comprehensiveness, fixed pattern of scoring and interpretation etc.
- The standardized test has the standardized provisions for being termed as valid and reliable as the test constructor always takes pains for

establishing reliability and validity of the test against the internal as well as external criteria

- The test is so standardized that it can be administered to any number of students (although of the same population to which it has been initially standardized) at any place at any time suiting to the administration of the test.
- The scoring procedure of the test items is quite fixed or standardized by providing a key and chalking out the detail of the scoring procedure (Both of these lie within the manual of the test developed by the test constructor).
- The interpretation of the raw scores attained by the students in the test is also quite fixed and standardized. There is a provision of transforming the raw scores into standardized scores that can be helpful in inter-subject achievement comparison. In addition, norms (mostly in the form of percentiles in the achievement tests) are also given for having a comparative analysis of the achievement of an individual student with the other students of his group or entire population of the test.

In this way, standardization of an achievement test provides the test all the necessary advantages for being used as a reliable, valid, objective, and more functional and useful tool for measuring and comparing the achievements of an individual or group of students in a given situation at a number of times.

Teacher-made Tests

Teacher made tests are not so formal, fixed and standardized as the standardized tests. True to their naming these tests are constructed by a teacher himself to measure the achievement of his pupil from time to time. They may be oral, practical and written (Essay, short answer as well as objective type) tests. Such tests have a limited area of application and are prepared almost by all teachers according to their requirements. Practically speaking in our school education a subject teacher is more concerned with the teacher-made tests in comparison to standardized tests. It is directly involved in their construction. Moreover the teacher made tests have an advantage over standardized tests because they can be constructed to measure outcomes directly related to class-room specific objectives and particular class situations. They are within the means of every teacher and most economical.

Teacher made tests as said above may be oral, practical and written tests. Let us know about them.

A. Viva-voce or Oral Tests : Such tests are based on oral communication between the examiner and examinees. Here in general oral questions are put to the students for being responded by them in oral form. Besides question-answer, the other verbal communication and dialogue techniques like interviews, quizzes, group discussions, panel discussions, debates and declamation contests symposiums etc., may also be used for evaluating students' abilities and learning potential in oral form.

B. Practical Tests : In such tests students are required to demonstrate their learning performance by engaging themselves in experimental and work activities. They have to create or produce something, report their observations of a relevant phenomenon, demonstrate the applicability of theoretical information in a concrete form and perform some motor behaviour or skilled activity as asked to be done for testing their behavioural outcomes related to cognitive, conative and affective domains.

C. Written Tests : Such tests require the use of writing material like paper and pencil from the examiner and examinees. Students receive test questions through written media known as question paper and are required to give their responses on the supplied answer sheet or on the question paper itself in the written form. The scoring and interpretation of these answer sheets or written responses thus becomes a basis for the evaluation to the teaching-learning outcomes, performance and abilities of the students. Written tests are the most frequently and popularly used evaluation techniques. These written tests are usually available in two major forms — Essay Type and objective type. Let us know in detail about these two types of written tests.

Subjective or Essay Type Tests

Subjective Essay type tests are quite traditional in nature. The typical features of these tests are as below.

- The items or questions included in these tests follow the essay type format. These questions ask the students to respond by providing quite lengthy descriptive, detailed and elaborate answers. The answers given by the students are so lengthy and descriptive that these might look like essays on the related subjects.
- Students are at liberty to respond to the presented questions in a way they like.
- There is much scope and relaxation in the name of choice to answer less questions than appearing in the test. For example, if there are 9 or 10 questions in the test paper, the students are provided choice to answer any five out of them.

- There is full subjectivity on the part of the evaluator (the teacher who evaluates the answer sheets) to provide scores for a particular answer of a essay type question.
- The nature of the essay type questions set in these essay type tests may be made clear through the following illustrative questions.
 1. What are the Newton's three laws of motion? Discuss in detail, citing suitable examples.
 2. What are electrons? How are they distributed in different shells? Explain with examples.
 3. What is nuclear energy? How is this energy being produced? Explain in detail.
 4. Throw light on the main causes, events and failure of our first Independence war of 1857.
 5. What do you mean by natural Resources of a country? Discuss in detail the Natural Resources of our country.

In case we try to analyse the strengths and limitations of essay type examination under the criteria of a good test or measure of evaluation. We can come to the conclusion that the system of essay type test or examination suffers from the evils and defects like below.

1. Low Validity : The essay type of tests/examinations are known for its low validity as they hardly try to measure what they ought to measure. Instead of assessing the knowledge and understanding of the subject as well as the ability of applying it to actual life situations, they stress on the ability of one's memory, and many other useless things like quality of the language used, handwriting drawing and sketching etc.

2. Low reliability : The essay type of tests/examinations are takes as quite unreliable on account of a high degree of inconsistency in their working in terms of the marking or results. It becomes obvious when on answer book the marks awarded by the different examiners show quite significant differences and more interesting when the same examiner assigns the quite different marks at the different occasions. In such a case how a tool or technique of valuation may be taken as reliable when its measurement differs in such a stupidious way.

3. Highly subjective : The essay type tests or examinations are subjective in nature. The results are very much influenced on account of the subjectivity on the part of both the examiners and examinees. The mood, liking and dislikings, whims, prejudices, and attitudes of the examiners as well as the examinees cast a major influence over the outcomes in terms of marking of the examination papers.

4. Less comprehensive : The essay type tests or examinations do not at all exhibit the quality of comprehensiveness in terms of covering the whole syllabus or assessing the total learning experiences gained by the students. There are usually 9 or 10 questions that are set from the whole syllabus. It is beyond imagination that how can these few questions represent the whole syllabus and one's performance in terms of knowledge gained, understanding developed, and skills achieved, etc. Still more, the students are instructed to answer only five out of these 9 or 10 questions. It is certain that they are compelled or persuaded to pay attention over a limited portion of the syllabus in order to get more marks through the so selected portion. Consequently, this system of examination encourages selective teaching and learning of the expected questions or portions of the syllabus.

5. Over emphasis on cramming : In this type of testing much emphasis is laid on cramming. The students try to memorize word to word of the text, the solved keys, guides and cheap help books for vomiting out the answers of the almost routine type essay questions in these tests. Commenting upon this negative aspect of essay type tests the noted educationist B.S. Bloom writes, "In India the system of education consisting of examinations, curricula, syllabi, text-books and methods of teaching has formed a grand conspiracy wherein every body concerned with education has come to believe that learning is to be equated with rote memorization."

6. No consideration for the practical and applied aspect of the subject : The existing essay type tests try to assess only the theoretical knowledge of the subject by ignoring completely its practical application and applied aspects. It has resulted in ignoring the practicals, demonstrations and laboratory work concerning the scientific facts and principles in the process of teaching and learning.

7. Not helpful in the realization of the objectives : The objectives, learning experiences and evaluation concerning the teaching learning of a subject are definitely interlinked and inter-dependent. As a result the evaluation scheme must work and help for the realization of the stipulated objectives. Contrary to this, the essay type tests or examinations work against the spirit of the realization of the objectives of science education by over-emphasizing on cramming, theoretical study of the subject and discouraging the reflective thinking, heuristic attitude and creativity on the part of the learners.

8. Generates undesirable habits : This system of testing or examination has encouraged, the development of so many undesirable habits among the students. The chance factor plays a key role in getting success in the essay type testing. The students think that they will be able to do well by

cramming a few selected questions just a few days before the examination. Consequently they begin to neglect the regular study in the subject and pick up the habit of negligence towards their duties, unpunctuality, irregularity and carelessness. They also become indisciplined in their work and behaviour. Since, the performance in terms of getting good marks is the only purpose, the students try to use every means, fair or foul for its attainment. It has resulted in down grading the moral values of the students. In this way, the traditional type of examination is responsible for the nourishment of so many evils and bad habits.

9. Difficulty in scoring and interpretation : The essay type testing or examinations pose a great difficulty to the examiners in terms of scoring the answer books of the students as well as deriving necessary interpretation out of these scores. It is very difficult to read carefully the lengthy answers of the essay type questions and then to take valid judgement of assigning very appropriate marks by making proper distinction among the answers of the different students. Sometimes, the students get varying marks for the almost same type of answers for no fault of them on account of the difficulty faced by the examiner in their proper scoring. It is only on account of the very nature of the essay type questions that are set in the traditional examination or tests.

For doing away with the above cited defects and shortcomings of the system of testing and examination, an alternative has been put up by suggesting to replace essay type testing or examination will objective type testing or examination. Let us see what do we mean by objective type tests or system of examination.

Objective type tests

Objective type tests are those tests in which the test developer makes use of objective type questions in writing the items or questions of his test. In addition, the objective type tests are also known for their wide coverage and comprehensiveness. Quite a large number of questions/items appear in an objective type test providing full coverage to all the concepts and aspects of the subject matter being dealt in the classroom by the teachers. There is also no choice available for the students in answering the questions.

There is also a sufficient scope for the test developer to make use different types of formats for framing and wording the objective type questions of his test. The nature of these objective type questions appearing in the objective type tests may be made clear through the following illustrations.

1. True-False Type : This type of questions are in the form of a statement which may be either true or false. The student has to tell whether it is true or false by writing Yes/No, True/False, correct/incorrect or marking \checkmark or \times at the given place.

Example : Below are given some statements you have to tell which one of them is true and which is false by encircling the true/false written in the right hand column. Don't encircle unless you are sure for its correctness or incorrectness because there will be negative marking for the incorrect responses.

Statements	Your Judgement	
	True	False
(i) The sun rises in the west.	True	False
(ii) Sunlight is essential for the growth of plants.	True	False
(iii) Mercury is a bad conductor of heat.	True	False
(iv) Sikkim is a Union Territory.	True	False
(v) The third battle of Panipat was fought in 1526.	True	False

2. Completion Type : In these type of questions students are asked to fill up the gaps left in the given statements by writing down suitable words or figures etc.

Example : Fill up the blanks :

- (i) The instrument for measuring atmospheric pressure is known by the name.....
- (ii) Days and nights are caused by.....motion of the earth.
- (iii) The moon.....round the.....
- (iv) 40°F is equal to.....degree centigrade.

3. Multiple Choice Type : In these type of questions a number of answers, say four or five, are given for each of the questions. Out of these answers only one is correct. The students are required to pick up the correct answer.

Example : Pick up the correct answer from the multiple choices given for a particular question and write it in the space given on the right hand side.

- (i) The name of the instrument used for measuring temperature is :
- (a) Barometer (b) Thermometer
- (c) Hydrometer (d) Lactometer
- (e) Voltmeter

- (ii) Air is heated by the sun through :
 (a) Convection (b) Conduction
 (c) Radiation (d) Convection and radiation
- (iii) Which state in India has a separate constitution ?
 (a) Sikkim (b) Goa
 (c) Nagaland (d) Jammu and Kashmir

4. Matching Type : These type of questions have two columns, one for the questions and the other for answers. The answers written in the second column are not necessarily of the same order as the questions in the first column. The students are required to match the answers with their respective questions. To put check on guessing, the number of answers given in the right hand column may be kept one more or less than the number of questions on the left hand side.

Example 1. Match the answers for Column B with the questions in the Column A and write the suitable number in the space provided.

Column A	Column B
(a) Unit of measuring heat.	(i) Watts ()
(b) Unit of measuring wavelength.	(ii) Calories ()
(c) Unit of measuring electric resistance.	(iii) Hertz ()
(d) Unit of measuring power.	(iv) Ohms ()
(e) Unit of measuring temperature.	(v) Degrees ()

Example 2. Match the following items in the two columns :

Column A (Nobel prize awarded)	Column B (Field)	Correct answer Code
(i) R.N. Tagore	(a) Peace	()
(ii) C.V. Raman	(b) Physics	()
(iii) Mother Teresa	(c) Medicine	()
(iv) Amartya Sen	(d) Literature	()
(v) Hargovind Khurana	(e) Economics	()

5. Simple Recall Type : In these questions, there are simple interrogative sentences which require very brief answers in the form of a single word or figure.

Example :

- (i) Name the type of image formed by the plane mirror. ()

- (ii) Name the gas employed for disinfecting drinking water. ()
- (iii) Where is the largest goldmine in India? ()
- (iv) Which state is the largest producer of copper in India? ()
- (v) What is the chemical name of vinegar? ()
- (vi) Name the scientist who introduced the equation $E = mc^2$. ()

6. **Time Sequence Type** : In such questions students are asked to provide sequential order for the given events/incidents/happenings, etc. Few examples are as follows.

- (a) A few historical events are provided here. Arrange them in a proper sequence by numbering as 1, 2, 3, 4, 5 etc. according to their time sequence.

- Kalinga victory of emperor Ashoka ()
- Invasion of India by Alexander ()
- The separation of Bangladesh from Pakistan ()
- The battle of Haldighati ()
- The battle of Plassey ()
- The establishment of East India Company ()

- (b) Arrange the following events related to First War of Independence, 1857 in a proper time sequence

- Emergence of Lord Canning as Governor General ()
- Emergence of Lord Dalhousie as Governor General ()
- Curtailing of the pension to Nana Sahib ()
- Denial of the permission to adopt a child as son to Laxmi Bai ()
- Ordering the Mughal emperor to leave the fort and palace ()
- Hanging of Mangal Pandey ()

7. **Discriminating or 'odd man out' type questions** : In these types of questions, there are a few names of things, persons or events except those ones which may be grouped together on account of some type of similarity among them. The students are asked to single out the one which does not go along with others. Some examples, are as follows :

- (i) Akbar, Jahangir, Bahadurshah, Muhammad Shah, Dara Sikoh, Shuja, Balban ()
- (ii) Tanya Tope, Bahadur Shah Jaffar, Kamwar Singh, Nana Sahib, Laxmi Bai, Subhash Chandra Bose ()
- (iii) Hyderabad, Mumbai, Shimla, Chandigarh, Bhopal, Sikandrabad, Trivendrum ()

Merits and Demerits of Objective Type Tests

Objective type tests carry both the merits and demerits outlined as below :

Merits

1. They are sufficiently reliable
2. They are highly valid.
3. Their objectivity is unquestioned.
4. These are quite comprehensive in terms of covering the syllabus and testing of the realization of the stipulated objectives
5. They can also serve the diagnostic purposes
6. The items in these tests can be properly graded.
7. The questions or items in these tests do not require lengthy answers. Therefore they do not result in bringing boredom and fatigue.
8. The scoring and interpretation of the responses of the students do not pose any problem in these tests. The use of scoring key, stencils or scoring machines further reduces the work of the examiner

Demerits and Shortcomings

Although objective types tests fulfil the criterion of an ideal test to a great extent, yet they are criticized for the following limitations and shortcomings :

1. Students do not get opportunity for the development of the power of expression and organization of their thought process.
2. The objective type questions test only the superficial knowledge of the subject.
3. It is unpsychological to give incorrect responses among the alternatives provided in objective type questions. In this way the students are often misled.
4. Objective type tests lack in diagnostic ability. The teacher can neither know about the difficulties of the student nor discover shortcomings in his own teaching through such tests.
5. These tests are costly in the sense that they require much labour, time, ability in their setting and preparation.
6. The main defect of such tests is in the fact that they encourage guess work.
7. Administration of such test invites many disciplinary problems. Students are tempted in unfair means as a simple gesture making or head nodding may prove quite beneficial to them.

But the above limitations or shortcomings are curable. If tried, a workable solution may be obtained. The following suggestions may be fruitful in this direction:

1. For an objective test containing objective type questions/items the students should be made to answer on a separate sheet other than the question paper.
2. Proper attention should be paid over the wise selection of the form and type of objective questions. As far as possible the forms like multiple choice, and matching type should be preferred over completion, and true/false type as they try to minimise guessing, cheating and encourage reflective thinking and deep study of the subject.
3. In order to put restriction on guessing the following measures may be adopted:

(a) To warn the students not to respond blindly or through mere guess as there will be a negative marking i.e., for every incorrect answer their will be automatic deduction of marks.

(b) For minimising the guessing effect in multiple choice items the following correction formula may be used:

$$S = R - \frac{W}{N-1}$$

where S = Corrected score

R = No. of right answers

W = No. of wrong answers

N = Number of alternative responses provided.

4. As a suitable alternative for enjoying the merits and benefits of essay and objective type tests, attempts can be made to incorporate both essay type as well as objective type questions in an achievement test. For reaping more benefit another form of questions known as short answer type questions may also be incorporated in the development of an achievement test. Let us know about the nature and form of these short answer type questions.

Short answer type of questions fall midway between the essay type and objective type questions. On the hand like essay type they do not need lengthy and detailed answers covering a number of pages and on the other

hand the responses to these questions do not limit or confine themselves to such small extent as yes or no, fill up the blanks or providing the answer in a single word or number. These questions, thus may demand the use of language, diagram or sketch but in a very simple, concise and brief way as may be evident from the language of the following questions:

1. Name the three modes of transmission of heat.
2. Point out the precautions to be taken while preparing oxygen gas in the laboratory.
3. Name the planets of the solar system.
4. What is the need for resource planning in a country?
5. How is the election for President is conducted in our country?
5. In addition of the above, attempts should also be made to give weightage to objective based tests. Let us see what are these tests and what type of questions are incorporated in these tests.

Construction of an Achievement Test

Construction of an achievement test is a serious job for a teacher. It requires adequate planning before hand. Usually this work can be properly accomplished by the following steps:

1. **Setting objectives:** The first and the most important step is to make clear oneself about the objectives for which one is going to frame the test. In all situations the objectives of the test should be properly decided and defined in terms of specific behaviour changes expected in the pupils as a result of studying a particular unit or course of study.

2. **Coverage of the syllabus or contents:** The contents which have to be covered in the test are directly dependent upon what has been taught by the teacher. The teacher should keep an outline of the learning experiences given by him. Although no major unit or subtopic of what has been taught should be left, yet it is not essential at all to ask for each and every thing discussed by the teacher in the class. In other words a reasonable coverage of various aspects of the learning experiences given to the students should be the goal.

3. **Decision about the types of items or questions:** Decision about the types of questions to be set in the test paper is also an essential aspect of its construction. As pointed out earlier, all the three forms-Essay type, short answer type and objective type should find place in a good achievement test.

4. **Decision about the time :** The total time given to the students for giving responses to the items of test should also be decided.

5. **Preparation of the Blue Print :** This is the most crucial step in the planning of the test. Blue-print is a short of the design for the test paper in which we present a detailed question wise distribution of marks over specific objectives, topics and forms of questions. Therefore, all the factors mentioned in the above four steps *i.e.* objectives to be tested, contents to be covered, types of questions to be asked and total time to be given, should be kept in mind while preparing the blue print or design of the test.

How the blue print is prepared can be understood through the following illustration :

Class VII

Time : 40 minutes

Total Marks : 25

Topic/Unit : Our Body System – Digestive, circulatory and Respiratory
Blue Print

Objectives	Knowledge	Understanding	Application	Total
Format of the Question → Sub Unit ↓	E S O	E S O	E S O	
Digestive System	2 2 1 (1) (2) (1)	- 1 2 (1) (2)	- 1 1 (1) (1)	10
Blood Circulatory System	2 2 1 (1) (2) (1)	- 1 2 (1) (2)	- 1 1 (1) (1)	10
Respiratory System	- 1 1 (1) (1)	- 1 1 (1) (1)	- - 1 (1)	5
Sub Total	4 5 3 (2) (5) (3)	- 3 5 (3) (5)	- 2 3 (2) (3)	25
Total	12	8	5	

Note : Digits given in the bracket indicate the number of questions set and out side the bracket provide the marks associated with the questions.

Question Type	Number of questions	Marks	Other descriptions
E-essay Type	2	4	(i) Scheme of option-None (ii) Scheme of Sections- - Part (A) essay Type - Part (B) Short Answer Type - Part (C) objective Type
S-short Answer Type	10	10	
O-objective Type	11	11	
Total	23	25	

6. **Organising and arranging the items or questions :** The items or questions to be included in the test require proper organization and arrangement. The following points may prove helpful in this direction.

- Essay and objective items should be kept in two separate sections with separate time limit for each. Short answer questions can be tagged on the either of these two sections according to their nature.
- Each section should have separate instructions common to both the sections.
- Items should be arranged in order of difficulty from the essay to the more difficult.
- In objective type of items it is advisable not to use too many different forms of items or questions as it involves some waste of time over reading instructions etc. As far as possible multiple choice items should be preferred as they are more reliable, valid and objective in comparison to other forms of items.
- It is better to have 20 to 30% items in excess so that in final review after items analysis the excess item may left out.

7. **Try out and Item analysis :** After planning as suggested above the test so prepared must be administered to an appropriate sample of students for its try out and suggested task of item analysis. Item analysis is mainly carried out for, serving the following useful functions :

- For finding out non-clarity, ambiguities, mistakes etc.
- For determining difficulty value of each item.
- For determining discriminating value of each item.

With the help of such analysis we can modify or get rid of defective items carrying ambiguities, mistakes and non-clarity as well as having too low discriminating and too high difficulty values.

8. **Designing or preparing the final form of the test :** As a result of try out and item analysis of the test the improper items can be deleted from the test. In addition few items may be suitably modified or even added for making the test more functional. This final form should then be got printed/ photostated/cyclostyted as the situation demands for the needed evaluation of the students achievements.

9. **Preparation of a scoring key :** To ensure objectivity in scoring it is advisable to have a predetermined way of scoring. It is not only the objective type items that require an advance preparation of a scoring key but also in case of essay and short answer type questions the answer and procedure for scoring should be pre-determined specifying the things like below :

- (i) The division of marks according to the sections or subsections in which an essay type question has been distributed.
- (ii) The number of steps or points expected in the answer.
- (iii) The number of lines or words expected for covering the answers of short and very short answer type questions.
- (iv) The weightage given to the steps or points expected in the answer of the students.
- (v) The nature of the model answer and weightage given for the steps or points explanation, illustration etc. mentioned in the model answer.
- (vi) Weightage given to the diagram, sketches, tables and illustration etc.

By following the steps narrated above, teachers can manage to develop the needed teacher made achievement tests for evaluating the progress of the students at the end of the delivery of their lesson or covering up of a specific unit or course during a session.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. What are achievement tests ? Discuss their types in the form of standardized and teacher made tests.
2. What are standardized achievement tests ? Point out their features and characteristics.

3. What are teacher-made tests ? Discuss the steps involved in the construction of an achievement test
4. What are essay type tests or examinations ? Discuss the defects and shortcomings of these tests in detail
5. What are objective type tests or examinations ? Point out and explain with examples the different types or forms of objective type tests. Point out their merits and shortcomings
6. What are objective type tests ? Point out their shortcomings and limitations and provide suggestions for getting rid of these shortcomings and limitations.

B. SHORT ANSWER TYPE QUESTIONS

1. What are achievement tests/Standardized tests/Teacher-made tests ?
2. What are essay type tests/Objective type tests ?
3. Point out the steps involved in the construction of an achievement test.
4. What is blue print of an achievement test ?
5. Point out the defects and limitations of essay type tests
6. Point out the defects and limitations of objective type tests

Existing Practices in Assessment

CHAPTER OUTLINE

- Introduction
- Semester system
- Grading system
- Choice Based Credit System (CBCS)
- Study Questions

Introduction

Assessment or evaluation as we have known and discussed in the previous chapters of this text helps us much in taking proper judgement about the learning outcomes of the students resulted through one or the other processes of teaching-learning. We make use of a variety of tools, techniques and devices for carrying out the needed assessment/evaluation of the learning outcomes of the students and then the needed task of scoring, processing, analysing and interpretation is performed for deriving necessary conclusions and getting needed feedback for bringing improvement in the processes and products of teaching-learning. The work carried out in all such aspects and dimensions of the assessment of learning outcomes needs to be quite systematic, objective and purposeful and therefore efforts are always made to bring necessary improvement in the practices employed in the field of assessment or evaluation. Various practices, policies and insights have emerged on account of a persistent struggle for bringing improvement in the system of assessment or evaluation. As a result, we may witness quite useful practices working at present in our system of the evaluation/assessment of the learning outcomes of the students besides many of them waiting for being practiced in the coming future. In this chapter, here we would like to discuss about some of the existing practices like semester system, grading and choice based credit system while leaving the discussion of emerging practices at the later stage.

Existing Practices in Assessment

Semester System

In educational institutions we have a full academic term known as the academic year or session for carrying out the instruction or other educational activities in the institution. In schools of our country the duration of this academic year usually ranges from April to March while in colleges and universities it extends from August to April depending upon the educational requirements, environment and circumstances prevailed in these institutions.

In most of our institutions the traditional system of examination is still persisting. In this system, examinations are taken only once after the end of the academic year. This system of examinations suffers from so many serious bottlenecks as discussed already in this very chapter. The most notable are (i) the lack of interactions, and co-ordial relationship between the teachers and taught, (ii) lack of continuity, in the process of evaluation for providing needed feedback to the students' progress and development and (iii) Slackness on the part of teachers and perpetuation of the evil of irregularities in teaching schedule or the lack of attention, interest and motivation about regular classroom. teaching-learning and self study on the part of students. The growth and perpetuation of such evils in the system of education has thus been responsible for destroying the very roots of the academic environment in our institutions. Teachers do not teach by complaining that students are not attending the classes and students do not care for attending classes regularly as their regular attendance and concentration over studies do not contribute much in their overall performance evaluated once in the year through the defective processes and tools of annual examination.

To do away with such sorry state of affairs, the educationists and reformists in examinations all over the world have come up with the proposal of enforcing semester system in the educational institutions. Let us see what it is.

What is the Semester System ?

In the traditional system of education and examination, the prescribed curriculum is to be covered in the full academic year or session. But in the semester system it is divided equally in two or three parts. Such divided portions of the curriculum are then to be covered in some fixed duration or time period called semesters. Accordingly, there are two or three semesters in a full academic year. Now each semester has a pre-determined portion of the curriculum of the various subjects to be covered in a definite time period of the semester by the respective subject teachers. The teaching-learning performed in a semester, is then subjected to evaluation at the end of the

teaching session of the semester and also in between the duration of the teaching session. In this way a semester system can be thought as a system of education and evaluation in which the prescribed curriculums of the various subjects are covered in some fixed time periods called semesters by having their two or three equal sub-divisions along with a properly laid down provision of continuous evaluation of the teaching-learning outcomes at the end as well as during the teaching sessions of the semesters.

The forms and Styles of Semester System

Semester System is usually enforced in two styles namely (i) Two semester system and (ii) Three semester system.

In two semester system, the task of the academic year is divided into two equal time periods or semesters. Each semester has a time duration of at least 18 weeks. Out of which 16 weeks are allotted for teaching and other related educational activities and two weeks are fixed for carrying out the evaluation work.

In three semester system the task of the academic year is divided into three equal time periods or semesters. Each semester has a time duration of atleast 12 weeks. Out of which 10 weeks are allotted for teaching and other related educational activities and two weeks are fixed for carrying out the task of evaluation.

Main Features and Attractions of the Semester System

1. In the semester system we have a provision of the teaching and evaluation of a definite sub-division of the prescribed curriculum to be covered in a particular semester. The whole task of the teaching and evaluation of the semester curriculum is carried out within the fixed limit of the time duration set for semester. It is never undertaken or repeated in the other semesters.
2. The evaluation task related to the semesters is carried out by having provision of (i) continuous internal assessment during the teaching session of each semester by organising internal class tests, giving assignments, holding quiz competitions and arranging group discussion and seminars etc. (ii) holding semester examinations (either internal or external) at the end of each semester.
3. It is almost obligatory for semester system to have provisions of continuous internal assessment as well as the final assessment of the teaching-learning outcomes related to different semesters. Here the teaching-learning work carried out during the semester must essentially have atleast two opportunities for carrying out the internal

assessment task. 10 marks each may be allotted for these opportunities and this way continuous internal assessment work may have a total of 20 marks at the disposal of the internal teachers. The examination or evaluation carried out at the end of the semester, then may be allotted 80 marks in each subjects. One can have more than two opportunities for carrying out the task of continuous internal evaluation, but the marks related to two best performance of the students only are counted towards the final assessment of the semester's progress.

4. The grading system is employed for judging the individual and group performance of the students in one or the other semester. We would like light on the nature and mechanism of the grading system very soon in this very chapter.
5. In the semester system, the teaching-learning and evaluation is well decided in quite advance. It makes the teachers, learners and school management personnel quite definite about their roles and responsibilities. They all remain quite goal directed, and motivated for executing their tasks within the fixed duration of the semesters.
6. The semester system has a valuable advantage in terms of providing a continuous and comprehensive evaluation of the teaching-learning outcomes and achievement of the students.
7. The semester system allows the teachers and students to confine and concentrate over a limited segments of the subject curriculum within the prescribed time duration of the semesters. They remain free from the anxiety and labour needed to cover the entire curriculum at a stretch in terms of its teaching-learning and evaluation.
8. The semester system allows the opportunities for having provisions of useful interaction among the students and between teacher and students. It adds to the promotion of mutual cooperation, understanding and co-ordial relations between the teacher and taught.
9. The semester system keeps the students and teachers quite alert and engaged in their respective task during the total time period of the semester. They can pay better attention and strive to go deep in the subject matter as they have a quite limited and definite portion of the subject curriculum for being covered by them in a particular semester period. The very fact that what is to be covered and get evaluated in the semester, provides them the needed physical and psychological relief for concentrating well on its teaching-learning and evaluation. Infact the very truth of non-repetition of the covered contents of the semester in the preceding or coming semester is quite enough to

provide sufficient weightage to the semester system over the traditional system of education and evaluation.

In this way, it can be easily concluded that the semester system may be seen to imbibe a lot of virtues and specialities for making it as a quite useful system of instruction and evaluation in our educational institutions. It can provide quite proper remedies for the evils of the existing education and evaluation system. It is why, we are hearing day by day the arguments in its support and more and more educational institutions including university teaching departments are opening their arms for enforcing the semester system in their campus.

Grading System

Grading system calls for providing letters grades to the students for their educational achievements instead of declaring them passed or failed or assigning numerical marks on a 100 point scale. It is preferred to the old system of percentage marking on account of the following reasons.

- (i) It is simple to assign grading than the exact numerical marking involving no biases and subjectivity.
- (ii) Examiners do differ in their marking on account of the subjectivity and standard of their marking. Grading reduces the subjectivity and unreliability on the part of the examiners.
- (iii) In the old system, there is a provision of pass-fail or assigning divisions 1st, 2nd or 3rd for a certain percentage of marks obtained by the students. Grading makes it more wider by providing more graded categories. There is a practice in the old system of bunching the marks at the end for declaring pass or assigning particular divisions. Grading system helps in removing this evil.
- (iv) Usually different subjects have different ranging marks, and combination of such heterogeneous scores as an aggregate or total marks for pass-fail or division is quite unsound and inaccurate from statistical as well as mathematical angles. Grading system provides good alternative for removing this defect.
- (v) Grading system provides scaling of the evaluation on a uniform basis for better comparison and combination of the evaluation outcomes in the different subjects and by the different examiners.

Methods of Grading. Generally two types of letter grades are assigned — one is to assign A, B, C, D or E and the other consists of assigning O, A, B, C, D representing outstanding, very good, good, poor or very poor level of performances. For assigning such letter grades generally two methods

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known as absolute grading method and relative grading method are employed. Let us discuss these ways.

Absolute Grading Method. In such grading method a pre-determined level or standard is fixed for assigning letter grades. It can be carried out in two ways.

- (i) A pre-established percentage scores required for a given grade is fixed. In other words we fix different ranges of percentage marks for assigning them grade letter like given below

Grade	Scores Percentage
O	80% and above
A	70-79%
B	60-69%
C	50-59%
D	Less than 50%

- (ii) Another form of the absolute grading is known as criterion-referenced grading. Here the criterion performance standard is fixed by the teacher or authorities in advance in the light of the difficulty level of the test and the standard or quality of learning performance needed from the learners. In other words, the decision is taken well before examining or testing the students that what performance (in terms of the changes in their behaviour) will help them to earn various letter grades. The performance level and letter grades can be represented as below :

Grade	Performance Level (in relation to the achievement of pre-determined objectives)
O	Outstanding (Excellent)
A	Above Average (Very good)
B	Average (Good)
C	Below Average (Poor)
D	Inadequate (Very Poor)

Relative Grading Method. In this method grades are provided on the basis of the comparative or relative positions (ranks) of the students in their class or group. In usual practice, relative grading follows the 'normal curve' distribution for the allocation of grades. The assumption is that in general, the distribution of marks over a population of students follows the distribution pattern of a normal curve. The area under the normal curve

may be statistically divided into equal segments helping us to mark the percentage of cases falling in each segment. This further may help us to take the decision like below.

Grade	Percentage of cases for being assigned the given grade
O	Top 7% of a class or group
A	Top middle 24% of a class or group
B	Middle 38% of a class or group
C	Bottom middle 24% of a class or group
D	Bottom 7% of a class or group

The decision about the top 7%, the next 24%, middle 38% and so on may be taken on the basis of numeral scores earned or performance level shown by the students on any evaluation measure. The students roll numbers may then be arranged in descending order on the basis of their numerical scores or performances ratings. Top 7% are then assigned grade O, next 24% grade A, another next 38% grade B and so on.

Choice Based Credit System (CBCS)

Choice based credit system (CBCS), a practice prevalent now a days in a number of colleges and universities represents an altogether new trend and practice in the field of education and evaluation-besides other practices like Semester System, CCE and Grading systems all ready existing in the system of education-school as well as higher education. Let us see what it is and how does it operate or function.

What is the choice-based Credit System (CBCS) ?

It is one of the major evaluation-cum-academic reform movement running at present in the existing higher education system through the initiation, guidance and support of the University Grants Commission (UGC). It mainly stands for providing needed autonomy to the learners and higher education institutions with a clear cut aim of bringing qualitative improvement in the evaluation-cum-academic system for meeting the challenges of the changed times particularly in reference to globalization.

As the name suggests, choice based credit system has two major distinctive features in the name of choice and credit.

A. The term choice in this system stands for

- (i) allowing the learners to make choices in terms of what to learn (choose from the prescribed courses i.e. subjects or papers referred as core, elective or minor or soft skill courses).
- (ii) allow them to make choices in terms of learning at their own pace

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- (iii) allowing them a choice or liberty to continue the studies in the existing institution or join other institution for their further studies with a facility of transferring credit earned so far to the newly joined institution/programs
- (iv) The term choices on the part of institutions (colleges or universities) here means that they have to enjoy greater freedom and autonomy in making their choices, about what to teach, and how. The decision about the running of the type of programs, courses etc. will be absolutely taken by them as they may consider appropriate for bringing quality in education within the framework of the National policy.
- B. The term credit in this system has its connection with the management and evaluation of the teaching-learning process and its outcomes. The system recommends to provide credit scores, on the basis of what has been taught/done in the institution in forms of the teaching of one or other courses and what has been learned by the learner as revealed through the ongoing evaluation process.

What has prompted to adopt choice based credit system ?

The question here may emerge that what has prompted to opt for choice based credit system (CBCS) in higher education.

1. There was a greater need for replacing teacher-centred and subject centred education system with a need based learner-centred education system.
2. The information giving and rote learning was dominating the entire system of evaluation-cum-academic system of the higher education. It needed to be replaced by a need based teaching-learning system. What is learned and taught in the institutions must have its direct link with the necessities, problems and expectations of real life. The courses, programs and activities should be so selected and executed as to help the learners in their present living and future prospectus.
3. There are great individual differences among the learners in terms of their learning potential, interests and future planning. Thus, there was a need of a wide variety of choices available for the students to opt for their learning at their own will and interests in the college and universities in relation to the study of a particular course or going through a degree/certificate program.
4. These was a pressure from the present generation youths on the colleges and universities in relation to address the issues like below.

- Why should not a student who is working on a part-time basis be allowed to stretch his studies in a college or university to four or five years instead of 3 years according to his convenience ?
- Why should there be a kind of compulsion to complete a degree program in three years ? Can it not be adjusted according to his own potential and learning pace ?
- Why is there no facility or provision to change from one college/university to other college/university with the transfer of credits earned from the former to the transferred college/university on the national as well as international basis ?
- Why there should not be a scope for collaborating with industries and employing institutions to have on the spot work experiences/ internship and earn credit scores for the same and why the same may not be included in computing the total credit for a program/course ?
- Why should not there be a change in the evaluation system in the form of continuous and comprehensive evaluation by providing weightage to their all round performances instead of the mere scholastic ones and make it a continuous and formative in its all way ?
- Why should not there be a proper provision of wide choices/options for the students in going through one or other courses according to their tastes, requirements and abilities instead of being forced to go through the fixed courses/subjects for passing out a program/obtaining degree in one or the other discipline ?

In this way there were many issues and pressures on the Government of India and concerning agencies responsible for the administration and organization of higher education, and also there were a number of recommendations available in this case from the reports of the committees and commissions like National Knowledge Commission (2008-2009), Yashpal Committee (2009), that prepared a proper ground for introducing choice-based credit system in the field of higher education.

How does the choice based credit system operate or function ?

We can try to understand the mechanism of the operation of choice based credit system under the heads mentioned below.

- Terminology used or key words employed.
 - Components or constituents of choice-based credit system.
- Let us try to discuss them one by one.

A. Terminology used or key words employed

In order to work with choice-based credit system, it is first quite essential to get acquainted with the terminology or the key words employed in its operation. UGC in its guide lines has provided the same in the following way.

- 1. Academic Year :** Two consecutive (one odd + one even) semesters constitute one academic year.
- 2. Choice Based Credit System (CBCS) :** The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses) and assigns credit for the course outcomes.
- 3. Course :** Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/ assignments/ presentations/self-study etc. or a combination of some of these.
- 4. Credit Based Semester System (CBSS) :** Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.
- 5. Credit Point :** It is the product of grade point and number of credits for a course.
- 6. Credit :** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- 7. Cumulative Grade Point Average (CGPA) :** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.
- 8. Grade Point :** It is a numerical weight allotted to each letter grade on a 10-point scale.
- 9. Letter Grade :** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
- 10. Programme :** An educational programme leading to award of a Degree, diploma or certificate.
- 11. Semester Grade Point Average (SGPA) :** It is a measure of performance of work done in a semester. It is ratio of total credit points

secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

12. Semester : Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.

13. Transcript or Grade Card or Certificate : Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

B. Components or Constituents of Choice Based Credit System

There are five ingredients or components of the choice-based credit system that need to be cared and organized well in the successful working of the choice-based credit system. These are :

1. Adoption of the semester system
2. Making provision for the different types of courses and their teaching
3. Use of credit system
4. Use of Continuous and Comprehensive Evaluation (CCE)
5. Employment of Grading System

Let us discuss each of them one by one.

Adoption of the Semester System

Working with choice based credit system needs to change from the conventional annual system to semester system on the part of the colleges and universities. For this purpose an academic year needs to be divided into two semesters with a clear division and specification of the work done under these semesters (e.g. duration of teaching-learning engagements, and conduct of assessment or evaluation etc.). Here care is taken that the teaching work as well as assessment is performed semester wise. However, a students' progress should be judged on the basis of the courses taken rather than time taken (like three years for science, arts ; commerce or four years for engineering etc.). Each semester according to UGC norms needs to have a minimum of 90 teaching days for teaching-learning engagements

Making provisions for the different types of courses and their teaching

Choice based credit system is essentially characterized with having the provision of wide choices in terms of opting one or the other courses

according to the needs and interests of the learners. In view of the guidelines issued by the UGC, courses in a programme (educational program earning of degree) may be of three kinds outlined below

1. Core Course : There may be a Core Course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

2. Elective Course : Elective course is a course which can be chosen from a pool of papers. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

An elective may be "Generic Elective" focusing on those courses which add generic proficiency to the students. An elective may be "Discipline centric" or may be chosen from an unrelated discipline. It may be called an "Open Elective."

3. Foundation Course : The Foundation Courses may be of two kinds: Compulsory Foundation and Elective foundation. "Compulsory Foundation" courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines. Elective Foundation courses are value-based and are aimed at man-making education.

In addition to these three types of courses, there may be also non-credit courses available in the institutions which will be assessed as 'Satisfactory' or 'Unsatisfactory'. There will not be included in the computation of SGPA/CGPA. However, all the three main courses will be accessed and evaluated to provide an effective and balanced result.

Use of Credit System

In the choice based credit system, each course (core, elective and foundation) is identified by a unique course code. All courses do not possess equal weightage. While designing syllabus, a course can have defined weightage. These weightage are called credits. When the student passes the course, he earns the credits which are based on that course. If a student passes a single course (subject or paper) in a semester, he does not have to repeat that course later. A student can earn credits according to his pace. If for some reasons, he cannot cope with the study load or if he falls sick, he has the freedom to study fewer courses and earn fewer credits and he can compensate this in the next semester.

How credits are computed ?

In the prescribed courses for each semester, course credits are assigned on the basis of the number of hours required per week for lectures/tutorials/lab work/field work to complete the course in a single semester. A study course may require direct teaching or lecturing (L) or tutorial (T), laboratory/practical work or field work/project work (P). It can have only L components or only T or P components or combination of any two or all the three components. The basis of assigning credits for lecturing/tutoring as well as field work/project work/laboratory work is as under.

1 credit = 1 hour of direct teaching (lecturing or demonstrating)
or tutoring per week

1 credit = 2 hours of laboratory work/field work/project work per week.

A course of 3 credits may be so designed as to have 2 credit for theory (lecturing/tutoring) and 1 credit for lab work/field work/project work.

A course of 4 credits may be so designed as to have 3 credits for theory (lecturing/tutoring) and 1 credit for lab work/field work/project work.

The credit frame work for the core, Elective and Foundation courses for a semester shall be as under.

Core Compulsory	Generic Elective	Compulsory Foundation
Course I – 3 credits Course II – 3 credits Total 6 credits per semester	2 credits per semester	2 credits per semester
Core Elective (Allied)	Discipline centric elective/open elective	Elective Foundation
Course I – 3 credits Course II – 3 credits Total 6 credits per semester	2 credits per semester	2 credits per semester

Core courses (compulsory and elective) thus shall have a total of 12 credits per Semester, Elective course (generic and elective) shall have 4 credits per semester and the Foundation courses (compulsory and elective) shall have 4 credits per semester. The normal graduation program, thus, shall have 20 credits per semester and the total credits of all the six semester (under three academic years) shall be 120.

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Besides a normal gradual program a college/university may have the provision for honors and special level programs (degree courses) and according a general frame work showing respective credits to be earned for passing out those programs shall be as under.

Types of Program	Credit to be earned
1. G (General Level Program)	120 credits
2. A (Honours Level Program)	140 credits
3. S (Special Level) 4 years BS program	190 credits

Use of Continuous and Comprehensive Evaluation (CCE)

The implementation of choice based credit system needs to adopt the system of continuous and comprehensive evaluation for assessing or evaluating the learning outcomes of the students. A continuous assessment process in semester system is known popularly as internal assessment generally performed by the course teacher/instructor by a variety of means like written test, observation of the practical/laboratory work, seminars, field work, presentations, quizzes, group discussions and tutorials etc. The feedback received through such continuous and formative evaluation should be used properly for bringing needed improvement in the ongoing teaching-learning process.

Employment of Grading System

Grading is a quite essential component of the choice based credit system. Grading can be performed by making use of the methods-relative grading or absolute grading as discussed earlier in this chapter.

The UGC recommends a 10-point grading system with the following letter grades as given below for the gradation of the students learning performance in each of the course of the semester.

Letter grade	Grade point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

In addition to this, attempts will also be made to compute Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) for all the students. Let us see what are these and how are they computed.

Semester Grade Point Average (SGPA) indicates the overall performance of a student in a given semester. It is based on the total credit points earned by the student in all the courses and the total number of credits assigned to the courses in a semester. It is computed by the use of the following formula

$$\text{SGPA} = \frac{\text{Total credit points earned in a semester}}{\text{Total credits for that semester}}$$

Where credit point for a course included in the semester can be computed by using the formula given below.

$$\text{Credit point for the course} = \text{No. of credits assigned for the course} \times \text{Grade point secured in the course}$$

Cumulative Grade Point Average (CGPA)

It shows overall performance of the student in all the courses of the all semesters of a program helpful in earning the required degree. It is computed with the use of the following formula.

$$\text{CGPA} = \frac{\text{Total no. of credit points in all the semesters}}{\text{Total no. of credits in all the semester}}$$

An illustration of the Computation of SGPA and CGPA

(i) Computation of SGPA

Course	Credit	Grade letter	Grade point	Credit Point (Credit × Grade)
Course 1	3	A	8	3 × 8 = 24
Course 2	4	B+	7	4 × 7 = 28
Course 3	3	B	6	3 × 6 = 18
Course 4	3	O	10	3 × 10 = 30
Course 5	3	C	5	3 × 5 = 15
Course 6	4	B	6	4 × 6 = 24
	20			139

$$\text{Thus, SGPA} = 139/20 = 6.95$$

(ii) Computation of CGPA

Sem. 1	Sem. 2	Sem. 3	Sem. 4	Sem. 5	Sem. 6
Credit : 20 SGPA : 6.9	Credit : 22 SGPA : 7.8	Credit : 25 SGPA : 5.6	Credit : 26 SGPA : 6.0	Credit : 26 SGPA : 6.3	Credit : 25 SGPA : 8.0

$$\text{Thus CGPA} = \frac{20 \times 6.9 + 22 \times 7.8 + 25 \times 5.6 + 26 \times 6.0 + 26 \times 6.3 + 25 \times 8.0}{144} = 6.73$$

Advantages of choice based credit system (CBCS)

The overall advantages drawn by the adoption of choice based credit system may be summarized as below.

1. It allows to replace traditional teacher centred and subject centered approach with learner centred approach.
2. It has a great advantage in its offering wide choices and options for the study of a variety of subjects. The approach adopted for providing variety of choices is nick named as cafeteria approach conveying the sense that one can have a thing of his choice to study and work in CBCS much in the same way as he gets things by placing order in the canteen.
3. It allows students to study with their own pace and to study one or the other course at his convenience.
4. It allows the students to study the courses beyond their own subject areas or disciplines. As a result a science student may have the opportunity to study the subjects belonging to humanity, commerce or language groups. It may enable them to gain knowledge and skills to other disciplines helpful in their all round growth and development.
5. It allows the students to opt for additional courses and achieve more than the required credits. Thus the creative, gifted and fast learners may get full opportunity for harnessing their energy in a fruitful way.
6. It has a big advantage in the name of transfer of credit helpful in
 - making the inter college/university migration possible for the needy students well with in the country and outside.
 - opting for one part of the course in one institute and the other part in another institute.
7. It allows the students for having more scope to enhance their skills and more scope of taking up projects and assignments, vocational training including entrepreneurship.

8. It can help in seeking needed cooperation and collaboration with the world of work, industries and employers for improving the skill potential of the country and providing job opportunities to the students.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. What is the semester system? How can it be helpful in doing away with some major defects of the traditional examination/evaluation system? Discuss in detail.
2. What is the grading system? Discuss its nature and functioning.
3. What is grading? How is it better than the traditional marking scheme? Discuss the methods and ways of grading the performance of the students.
4. What is choice based credit system (CBCS)? Discuss its nature and functioning in detail.
5. What is the need of adopting choice based credit system in our system of higher education? Discuss its various uses and advantages.

B. SHORT ANSWER TYPE QUESTIONS

1. What is a semester system?
2. What is a grading system?
3. Point out any two distinctive characteristics and qualities of the semester system.
4. Point out two main advantages of grading over the traditional system of marking.
5. What is choice based credit system?
6. Provide the formula for computing Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

Emerging Practices in Assessment

CHAPTER OUTLINE

- Introduction
- Computer based Online Examinations
- Open Book examinations
- Question Bank
- Flexibility in Examination
- Examination on Demand
- Study Questions

Introduction

In chapter seven of this text, we have discussed about some of the well known existing evaluation or assessment practices in the name of semester system, Grading and choice based credit system. The employment of such practices has helped us in doing away with a number of ills and evils associated with the traditional system of examination and evaluation. Attempts are further going on to introduce some more reforms under the pipe line. These have been experimented although in a limited capacity in some specific situations but their application on a large scale in a generalized way is still awaited. We can name some of these emerging practices in the field of evaluation or assessment as computer based online examination system, use of question banks, open book examination system, maintaining flexibility in examination including examination on demand etc. In the present chapter, we would be focussing our discussion on these newly emerged assessment practices.

Computer based on-line Examination System

Computer based on-line assessment represents a quite new emerging trend in the field of assessment/evaluation of the learning outcomes of the intended learners in the regular as well as on-line system of formal education.

Computer based on-line assessment or examination in its word meaning stands for a type of assessment or examination that is carried over on-line with the help of internet services or Local Area Network (LAN) of the computers. The main features as well as advantages of this computer-based online assessment or examination are summarized below:

1. Here the test paper or assessment is delivered to the learner for assessing the desired learning outcomes on line through a computer connected to a network.
2. The contents of this test paper or assessment may differ depending upon the purposes served through assessment such as formative, diagnostic or summative.
3. In the field of education and especially in case of teaching-learning, Online assessment is used primarily to measure cognitive abilities, demonstrating what has been learned after a particular educational event has occurred, such as the end of an instructional unit or chapter. When assessing practical abilities or to demonstrate learning that has occurred over a longer period of time an online portfolio (or ePortfolio) is often used. The first element that must be prepared when teaching an online course is assessment. Assessment is used to determine if learning is happening, to what extent and if changes need to be made.
4. The test paper appears on the screen of the computer before the examinee. He can now go through it for its responding. Usually there are multiple choice type questions included in the content of the test and the student/examinee is required to respond by clicking on one of the multiple choices.
5. On-line responding to the on-line test items carries a number of significant advantages to the students otherwise unavailable in the traditional paper-pencil tests. These have been properly emphasized in CBSE Website in connection with the employment of computer based on-line assessment in the manner as given below:
 - (i) The full contents of the test paper remain thoroughly open to the students at all times of their examination of assessment. They can review or re-answer any question at any point of time during the examination.
 - (ii) The candidates enjoy the freedom of changing the option of the answer during the entire examination duration through a simple click of the mouse.
 - (iii) The candidates also has the option to mark any answer for review at later stage during the examination.

- (iv) There lies a provision of showing all the question numbers in different colour scheme to indicate which of the questions have been answered, left unanswered and marked for review.
 6. In addition to get assessed through the use of a test paper, students here may get opportunities for the desired assessment of their learning outcomes in many other useful forms like submission of assignments, project reports, field work and survey findings etc.
 7. The use of new technologies such as web, digital video, sound, animations, interactivity and audio-video conferencing facilities and mobile connectivity available on computer and smart phone devices have given an altogether exciting opportunities for the online assessment. It is now quite possible to assess the learning outcomes or performances of the students sitting far away from the teachers with the help of audio-video display and interaction available online over the computers, laptops and smart phones. One can assess the proceedings of a seminar, group discussion, group project, laboratory work, or the independent creative and constructive output of the students well while sitting on one's computer or working with smart phone quite conveniently in a most satisfactory way. He can provide essentially immediate feedback to his students and pass judgement over their efforts.
 8. On-line assessment carried over computers/laptops/smart phones may prove quite helpful in carrying out various functions or purposes of evaluation in a quite satisfactory way such as
 - (i) using as a testing device for the assessment of previous knowledge before the teaching-learning of a concept.
 - (ii) fulfilling the needs and purposes of a diagnostic/formative/summative test or evaluation.
 - (iii) providing a means and platform for practice testing as students have the option of getting them tested at their will as and when they require so.
- Computer based online assessment thus can serve quite useful purposes in the assessment of learning as well as for learning in the field of regular and distance mode of teaching-learning. However, there lies a fear in its use expressed in general by the practitioners. It is related to academic dishonesty or cheating involved in the online assessment mostly in the form of identity fraud and plagiarism.
1. There are greater chances of identity fraud in online examination as one can appear for the other in answering the items online. To do away with such fraud the measures like below may be adopted.

- Use of supervised examination through the institutions testing center or require students to come in at a certain time for the examination.
 - To get familiar with a student through their voice and appearance by communicating with the students through phone or audio-video conferencing.
 - To personalize assignments to students backgrounds or current activities. This allows the student to apply it to their personal life and gives the instructor more assurance the actual student is completing the assignment. Lastly, an instructor may not make the assignments heavily weighted so the students do not feel as pressured.
2. Plagiarism is the misrepresentation of another person's work. It is easy to copy and paste from the internet or retype directly from a source. It is not only the exact wordage, but the thought or idea. It is important to learn to properly cite a source when using someone else's work. Useful websites and software are also available for identifying this fraud.

Open Book Examinations

What is an open book examination?

Open Book Examination represents one of the significant new approaches recommended for bringing reforms in the system of examination. *As a matter of definition an "open book examination" may be referred to an examination in which examinees are allowed to consult their class notes, textbooks, and other approved material while answering questions.* It has been named as an open book examination only on account of the freedom to have a book open before the examinees while giving answers to the questions asked in their examination paper.

The rationale behind adopting Open Book Examination

What has made to opt for open book examinations is a pertinent question that can be raised for introducing this reformatory measure at any place and level of school or college education. The things like below may be mentioned in support of opting for open book examinations.

1. **A cure for the menace of cheating and mass copying :** It is not at all unusual during the examination to witness the scenes of cheating and copying on the part of examinees. It may also take a shape of mass copying at a particular examination center where students may be seen to be making use of copying material at a mass scale and their friends, senior students, professional and even parents helping them in their act of cheating and copying creating a lot of problems to the supervisory and school authorities.

The reason is very simple. The temptation is quite high. There seems to be an easy short cut for faring well in the examination by just copying the answer from the torn pages or photo copies of a text, help book or notes and all huc and cries in the examination centers lie in availing this illegal and immoral practice on the part of the majority of the examinees. A number of means and measures may be suggested to exercise checks and control over this evil and they have been under trial since a quite long time. However, earnestly speaking they have failed in their mission. There seems a ray of hope in switching over to open book examinations in place of the tradition system of closed book examinations. Let us take a bold step. Set the examinations questions in such a way as to leave no scope and use of copying and cheating and allow the examinees to use the class-notes, text books and other printing or photo material for answering these questions. The fuss in the name of cheating and copying in the examination will automatically stop.

2. **Helpful in transforming learning process from information receiving to information processing :** The other major rationale, lying behind the proposal of open book examination, is related with the nature of education we want to give to our future generation. In our schools classrooms we have been emphasizing on "dissemination of knowledge". The students are persuaded to receive the information or knowledge related to different subjects of the school curriculum through direct instruction or from the learning sources like text books and other help books available for this purpose. They are supposed to mug up this information and retain it in their memory for being used in answering the questions asked in their internal or external examinations. It is thus a memory level teaching-learning that has been practiced in our schools for the teaching-learning and evaluation. At this age of rapid advancement, global competition and progress no country of the world can't afford to plan and organizing the education of its citizens in such an indifferent way. The emphasis need to be shifted from receiving information to information processing at the hands of the children. They should be empowered to know and learn the way of acquiring knowledge rather than merely receiving it from their teachers and texts. We have to equip our children with the ability and skills of knowledge construction and information processing.

They should be helped in development of their cognitive abilities to build new knowledge and to apply available knowledge to solve problems and make intelligent decisions. The main focus of teaching-learning thus will be on the skills of acquiring, modifying and creating knowledge, that is, on processing information, rather than on the information content itself.

It is therefore a need of the hour and necessity of the ongoing global changes that we have to switch over from an educational system based on transmission of knowledge and information to the construction and processing of the information. Needless to say, that our evaluation and examination system should also be modified and switched well in tune with the changes needed in the teaching-learning of our students.

We should stop asking such questions in the examinations that are totally dependent on the rote learning or memorization abilities of the students and that could be copied down or answered through the cheating and copying practices. Instead of it if we set such questions or get the examinees engaged in such activities that require the use of constructive, creative, logical, analytical, and other developed cognitive and applied skills or abilities of the students for testing their comprehension of the subject at the understanding and reflective level, then there hardly lies any risk in resorting to open book examination. It will help in removing the ill effects and melodrama of the rote learning and mechanical memorization. Students will not be having any phobia, anxiety and frustration of doing poorly on account of the failure of their memory at the time of responding to the questions. The facts and figures of the information required will be before them in the form of text books, class notes and other permissible printed material and they would be let free to provide proofs of their learning performances at the understanding and reflective levels instead of the memory level alone.

The reforms set in the mode of asking questions set in the examinations and system of open book examination introduced will automatically open the door of bringing appropriate modifications and improvement in the ongoing teaching learning classroom practices. The emphasis will shift on the proper processing of information, construction of knowledge and development of creative and constructive faculties rather than mere transmission and reception of the information and knowledge and over dependence of direct instruction and mechanical memorization.

Types and Forms of Open Book Examinations

In terms of their forms and shapes, the open book examinations may be categorized as below

1. Unrestricted type of open book examinations : These are the type of open book examinations that truly depict the very nature and purpose of open book examinations. Here no unwanted restrictions are imposed on the examinees. They are free to take with them and consult any text book or help book (with or without scribbles on the margin), lecture handouts of the subject teacher, their own handwritten notes or any approved material or

equipment for helping them in responding to the questions asked in the examination.

2. Restricted type of open book examinations : In the restricted type of open book examinations, students have no free access to texts, class notes and other printed material as happens in the case of unrestricted type of open book examinations. Here they may be permitted to consult printed documents such as the log tables, dictionaries, or prescribed texts of the subjects concerned, but no handwritten material or printed documents which have any scribbles on the margin or have no prior approval. Such unrestricted type of open book examinations neither represent the true concept of open book examinations nor have the required capability of fulfilling the missions and objectives of open book examinations.

The misconceptions and criticism about the practice of open book examinations

The introduction of the scheme of open book examinations may be found to suffer from a number of misconceptions and criticism standing against its proper use and applications like below.

1. Disinterest and apathy of students towards learning : It is assumed as well as feared that the adoption of the practice of open book examination may make the students feel that there is no need of studying and preparing for the examinations as everything is available for them in the examination hall for responding to the examination questions. However, it is totally a misconception and misunderstanding about the practice of open book examinations. The situation is otherwise. It is true that students do not need to memorize and keep so many facts, formulae and information in their memory for their use at the time of providing answers to the examination questions as access to such information is readily available to them in the system of open book examination, yet a mere access to such information is not sufficient, they need to be able to apply it effectively. In Open Book examination one needs to quickly find the relevant information in the resources one has with him in the examination hall. It can only be possible when a learner is able to fully understand and be familiar with the content and materials of his subject. Moreover, the learners who give enough attention in studying and learning the course material at the understanding and reflective level can only respond well to the type of questions asked in the open book examinations. In this way the responsibilities of the learners are bit increased in the open book examinations rather than providing them scope for being negligent towards their learning and studying of the subject in a proper way.

2. **Breeding negligence on the part of teachers :** It is feared that the practice of open book examination may drift the teachers away from their teaching responsibilities by getting them feel that there is no use of teaching and making the students serious about their studies as they will have open access to the needed sources for answering questions in the examination hall. However, this assumption on the part of teachers that they need not to bother about the study of their students is quite improper. The facts stand quite contrary to this misbelief. A teacher in the system of open book examination has to be more alert, attentive and prepared for the study and development of their students as he has to guide and assist them for the thorough knowledge, understanding and application of the course material. He has to help them for their understanding and reflective level of learning, develop their potential for the proper processing of the acquired information and make them capable of using their cognitive abilities for responding to the questions needing problem solving ability and creative or constructive imagination.

3. **Making mockery of the examination or evaluation :** It is also feared as well alleged that the adoption of open book examination will result in making mockery of the actual process of assessing and evaluating the students' performance or the process and products of teaching-learning outcomes. However, such fear and allegation does not hold much ground. In fact it is a better approach for testing and evaluating the real worth of the students in terms of their learning at the needed understanding and reflective levels. It is true that it does not provide undue importance and advantage to the learners' rote learning and memorization ability and do not test the level of retaining information but it tries to test their other essential abilities, skills and potential helpful in the proper understanding and application of the course contents. Therefore it is quite worthwhile to make use of the open books examination practice and the fears and allegation against it use are ill founded.

The impact and implications of the practice of open book examinations

The adoption of open book examinations will exercise a sizable impact over the whole system and process of education mainly mentioned as below.

A. Impact over teachers and their teaching

1. Teachers will have to work more in preparing students for facing the challenges put up by the introduction of open book examination practice. Since the questions asked in these examinations will need the use of appropriate mental skills, creativity and constructivism on

- the part of students. Teachers will have to work for the development of such skills and abilities among their students
2. The teachers' role will be changed from a mere information giver to a facilitator, guide, trainer, consultant and assessor. Accordingly they will now switch over their teaching functions from prescriptive to the provocative, from providing knowledge to empowering students to acquire knowledge, from furnishing students with a finite body of knowledge to equipping them with higher order cognitive skills and from dependency to taking ownership of the learning experience.
 3. There will be a complete paradigm shift in the use of teaching methods, strategies and techniques on the part of teachers. Methods involving direct instruction, mechanical memorization and habit formation will not work. The behavioristic approach of teaching will have to be replaced by cognitive and constructive approaches or methods of teaching. As a result, attempts will be made to shift the focus from teaching a body of information to teaching how to process and apply it.
 4. Consequently the strategies like guided discovery, problem solving method, collaborative and cooperative learning, project and activity centered approach and self-study and assignment based teaching-learning programs will be promoted and efforts will be made to provide opportunities for the students do make use of their mental abilities for solving challenging problems, analyzing and synthesizing the given facts and reason out new ways and methods of doing things.
 5. Here as far as the overall nature of the teachers' teaching is concerned, the main focus of teaching will shift on the skills of acquiring, modifying and creating knowledge, that is, on processing information, rather than on the information content itself. In other words, teaching will no longer be the transfer of information from the teacher to students. It will be the training of the mind in certain intellectual skills.

B. Impact over students and their learning

1. The most immediate impact on students will be that they will stop "mugging" or rote learning. The focus of learning will shift from a memory level learning to understanding and reflective levels of learning.
2. It will put a halt to their habit of copying and cheating in the examinations.
3. The challenges put up by the type of questions asked in the examinations and the techniques and preparation needed for taking

advantages of books and printing material available in examination hall may demand from the students to engage in active and meaningful learning. They will now try to learn the way of acquiring information, constructing knowledge with their own attempts and processing the acquired information for solving the faced problem and answering the raised issue.

C. Impact over the framing of the test questions

The significant changes will be now visible in the nature of the test questions framed for the open book examinations. There will be no use of asking the questions like "When the first battle of Panipat was held and who were involved in this battle? Tell about the phenomenon of solar eclipse or lunar eclipse. Students can easily find their answers in the books and material available to them in the examination hall, and copy them in their answer books. The test framers have to take care of the fact that the aim is not to test the rote learning and information retaining ability of the students. They have to design such test questions and program the administration of the test in such a way as to make it capable of (i) testing the students' understanding of the acquired knowledge of a course, and the skills of applying that understanding in a maximum useful way (ii) discouraging the tendency of copying the answers of the questions from the books and notes.

Knowing so far, thus we may now conclude that open book examination system can be really credited as a quite bold and big step for bringing needed reforms in the prevalent system of examinations. Tried in a proper way it can surely help in restoring the true meaning of the word education for both teachers and students. There may be some difficulty in setting the right type of questions in the beginning, but it will go away soon if genuine attempts will be made by the researchers and teachers for doing so.

Question Banks

As the name suggests, these are the banks or treasures (available in the printed and bound form or computer software) from where we can have a number of questions set on each subject for the evaluation of the students. Emphasizing upon the need of maintaining such treasury of questions, National Curriculum Framework (NCF), 2005 has put up its views in the following words.

"In order to improve the validity of current examinations, the entire process of paper setting needs to be overhauled. The focus should shift to framing good questions rather than more paper setting. Such questions need not to be generated by experts only. Through wide canvassing, good questions can be pooled all year around, from teachers, college professors in that

discipline, educators from other states, and even students. These questions, after careful vetting by experts, could be categorized according to level of difficulty, topic/area, concept/competency being evaluated and time estimated to solve. These could be maintained along with a record of their usage and testing record to be drawn upon at the time of generating question papers." (NCF, 2005 : 114)

Viewing in this manner the use of question bank may prove quite advantageous and helping hand to the paper setters in terms of the supply of well framed and standardized set of questions for various class levels and learning areas.

However, besides serving the need of supplying questions of good quality to the teachers and paper setters for the one or the other examinations, these may also be found to serve the following useful purpose of a good evaluation in the areas and aspects like below :

- In the diagnostic task carried out by the teachers for their students
- To the teacher at the introductory, developing and final stage of his lesson.
- Drill work and home assignment can be properly given with the help of these questions.
- Need of the individual differences can be successfully met with the variety of questions available with varying difficulty levels.
- In the development of the instructional programme, curriculum, and instructional strategies these questions can be very well utilized
- To have questions well related to the instructional objectives of all the behavioural domains and levels.
- In the proper scoring and interpretation of the student responses.
- In providing proper instructions to the examiners and examinees.
- In organizing teaching and learning at all the three levels - memory, understanding and reflective.
- To set before the learners the required learning objectives and keep them purposefully motivated in the classroom instructional work or self-study.

Regarding their overall impact and usefulness it can be well said that the questions available from questions banks are framed with utmost care with all the technical formalities and statistical soundness, so that these may help in proper evaluation of the potential and learning outcomes of the students.

As regards the availability of these question banks, we may approach NCERT, SCERTs located in various states, UGC, universities, colleges, state libraries, various examining and testing bodies, private publishers, etc.

Flexibility in Examination or Assessment

In the name of existing traditional system of examination or assessment we are adopting one-exam-fits-all principle for planning and organizing examination or evaluation programs for the students. There is a lot of rigidity and no flexibility is found in planning and organising these examining and assessment programs. However needed flexibility is essential for a good system of examination and assessment proving as a proper means and media for the assessment of learning outcomes of the students in the formative as well as summative shape.

Why flexibility is needed in the system of examination or assessment ?

In building the cause of introducing flexibility in the system of examination or assessment NCF-2005 has provided the following arguments in its favour.

1. A lot of psychological data now suggest that different learners learn (and test) differently. Hence there should be more varied modes of assessment beyond the examination hall paper-pencil test.
2. Because of the different nature of learners, and the widely variable quality of teaching, the expectation that all candidates should demonstrate the same level of competence in each subject in order to reach the next level of education is unreasonable. In the light of the urban-rural gap in India, this expectation is also socially regressive. It is well documented for instance, that much of the higher failure and dropout rates in rural schools can be attributed to poor performance in two subjects – Maths and English. Boards should explore the possibility of allowing students to take exams in these subjects at one of the two (or even three) levels.
3. The "one-exam-fits-all" principle, while being organisationally convenient, is not a student-centred one. Nor is it in keeping with the rapidly evolving nature of the Indian job market, with its increasing differentiation. The industrial assembly-line model of assessment needs to be replaced by a more humanistic and differentiated one. If, as economists predict, four out of every four new jobs in the next decade will be in the services sector, a paradigm shift in Indian education is called for. As fewer and fewer Indians make standardised

widgets, and more and more work to solve problems for their fellow citizens, the Indian exam system will also need to become more open, flexible, creative and user friendly.

How flexibility can be introduced in the system of examination or assessment ?

For introducing flexibility in the system of examination or assessment there is a need of adopting varied tools and techniques of assessment as well as alternative means and modes for the assessment of learning outcomes or performances of the students other than those which, are being traditionally employed for the purpose. In brief the adoption of measures like below may prove fruitful for this purpose.

1. The implementation of the scheme of continuous and comprehensive evaluation (CCE) in its proper form paving the way of assessing learning outcomes in all the three domains of learner's behaviour in a continuous and comprehensive way.
2. Adoption of Semester System, scheme of internal assessment, day to day behavioural observation as well as maintenance anecdotal and cumulative records of the learner's achievement and progress.
3. Providing needed emphasis on the assessment of the scholastic as well as non-scholastic areas aimed for the holistic development of the learners in tune with their individual capacities, interests, motivation and goals of life.
4. Making use of a variety of assessment tools and techniques helpful in assessing behavioural outcomes of all the domains such as tests (achievement tests and psychological tests), oral written and practical examinations, use of observation, rating scales, check lists, questionnaires, interview, portfolio assignment, seminar presentation, project reports, profile analysis, case studies, and sociometric techniques etc.
5. Introducing alternative modes of examination and assessment such as adoption of computer based on line examination system, self assessment, peer assessment, choice based credit system, examination on demand, open book examination and examination without time limits etc. The last two modes in this series examination on demand and open book examination system are worth mentioning efforts in providing a lot of freedom and flexibility for the examinees for being assessed in terms of the learning attainments in the various curricular areas. We have already thrown light on the adoption of the system of open book examination in this chapter and would be dealing with 'examination on demand' here in the coming pages.

Examination on Demand

The system of examination on demand rests on the very principle that a student should be tested or examined only when he demands so according to his need or convenience. The necessity of introducing this alternative mode of examination or assessment has been felt on account of the need of bringing essential flexibility in the traditional mode of examination. It is an open fact that traditional system of conducting examination only once or twice a year and on fixed dates does not meet the criteria of openness and flexibility in learner's assessment. The concept of 'examination on demand' has emerged on the scene for providing needed flexibility, openness and freedom to the learners in getting evaluated or assessed according to their learning place, readiness for being assessed and convenience felt on their part for appearing in the examination at one time or the other.

Realizing such need NCF-2005 has also suggested on the part of school boards "to work towards 'on demand' examination, in which students can take as and when they feel prepared" (NCF, 2005 : 113). In our country, the system of 'on demand examination' is being practiced (i) at the secondary level of school education in the open schooling, India, and (ii) at the higher education stage by the National Council for Innovations in Distance Education (NCIDE), IGNOU, New Delhi.

On Demand Examination In National Institute of Open Schooling (NIOS)

National Institute of open schooling has been working on the concept of On-demand examination (ODE) at secondary level since 2003 with the clear cut objectives of (i) making the total system of examination independent of the time frame and (ii) helping the students to take up the examination as per their wish and preparation.

In this way the basic concept followed by on demand examination system of NIOS is to allow its students to walk into examination centres established by it as and when they feel ready for the examination.

With the success of 'On-Demand Examination' at secondary level, NIOS started the On-Demand Examination in Senior Secondary also from October 2007.

At present, ODES is being conducted at NIOS HQ at NOIDA and at its 13 Regional Centres/Sub Centres of NIOS in the following subjects at Secondary and Sr. Secondary level.

Secondary : Hindi, English, Sanskrit, Mathematics, Science & Technology, Social Science, Economics, Business studies, Home Science, Data Entry Operations, Psychology, Indian Culture & Heritage, and Painting.

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Sr. Secondary : Hindi, English, Sanskrit, Mathematics, Physics, Chemistry, Biology, History, Geography, Political Sc., Economics, Business Studies, Accountancy, Home Science, Psychology, Sociology, Painting, Environmental Science and Data entry Operations

Medium of Question Paper : The Question Paper is available in English and Hindi Medium Only. However the Regional Medium Candidates who are provided a choice of answering the Question Paper in the respective Regional Medium but no regional medium question paper is supplied to them for the purpose.

On-Demand Examination in Distance Education mode of IGNOU

The scheme of on-demand examination is fully operational in the distance education system governed by IGNOU, New Delhi. It is being implemented for more than 135 courses run in distance education mode with the help of 18 regional centres. It provides opportunity to the students for appearing in on-Demand Exam as per their need and convenience. The software for generating individualized question papers and for on-line registration for On-Demand exam have been developed in-house in NCIDE with the help of the Students Evaluation Division, Regional Services Division and the Regional Centres of IGNOU, the scheme of On-Demand Examination is now fully operational. The unique features of scheme include online submission of registration fee, issue of online hall ticket, online attendance record etc. The software can generate a large number of unique and parallel question papers exactly in accordance with the design and blueprint provided by the faculty.

Presently the facility of On Demand Examination is available in 135 courses of different programmes through 18 Regional Centres of IGNOU, including Aizwal, Bhubneswer, Cochin, Chennai, Dehradun, Delhi-1, Delhi-2, Hyderabad, Jabalpur, Jammu, Jaipur, Karnal, Koraput, Madurai, Nagpur, Noida, Ranchi and Srinagar.

The main advantages drawn through the system On-Demand Examination (ODE)

The main advantages available through a system of on demand examination may be briefed as below :

- It allows the student to take examination when he/she is ready. Readiness depends on the Student and not on the institution.
- It permits the student to choose the date of his/her examination.
- It reduces the threat of failure in examination.

- It removes frustration, loss of self esteem, peer group ridicule, and depression that are generally characterized by the Term-End Examination.
- Under ODE; the degree and level of performance is decided by the student who can reappear in the examination as many times as he/she wants, till satisfied.
- ODE is also helpful in containing malpractices in examinations, as it is a system where the tools for evaluation are unique for individual student. The question paper for each student is different having comparable difficulty level.
- ODE respects the *individuality* and *sovereignty* of the student.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. Discuss in detail the nature and functioning of any one of the following emerging practices in assessment.
 - (a) Computer based on-line examination system
 - (b) Open book examination system
 - (c) Question Bank
 - (d) Flexibility in Examination
 - (e) Examination On-Demand
2. What is computer based on-line examination system? Discuss its features and mode of operation.
3. What is an open book examination? What is the rationale behind opting for open book examination? Discuss.
4. Discuss the various types and forms of open book examinations alongwith the accompanying impact and implications of adoption of the system of open book examination.
5. Discuss the utility and functioning of question banks in the system of evaluation or assessment.
6. What do you mean by flexibility in examination or assessment? Why it is needed and how can it be introduced in our system of examination or assessment?
7. What do you mean by the term examination on-demand? Discuss its concept and operation in the light of the practices adopted by National Institute of open schooling for school education and IGNOU for higher education.

B. SHORT ANSWER TYPE QUESTIONS

1. What is computer based on-line examination system/open book examination system/on-demand examination system?
2. Name the various types and forms of open book examination system.
3. Point out three merits of question banks.
4. What do you mean by flexibility in examination or assessment?
5. Why flexibility is needed in examination or assessment?
6. Name the four advantages drawn through the adoption of on-demand examination system.

Diagnostic Testing and Remedial Teaching

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CHAPTER OUTLINE

- Introduction
- Meaning and purpose of Diagnostic testing
- Distinguishing Diagnostic tests from the achievement Tests
- Purpose of Diagnostic Tests
- Preparation of Diagnostic test
- Remedial measures
- How to take Remedial measures ?
- What is Remedial Teaching ?
- Organisation of Remedial Teaching
- Study Questions

Introduction

Remedial education is meant for the students who are in need of it in order to overcome their learning difficulties. The students termed slow learners, backward or who by one or the other reasons shows poor performance in learning are provided such education. For an instance there is a student who repeatedly shows poor performance in the achievement tests, is unable to answer the questions put to him in the class, neglects his home task, demonstrates inability to perform certain experiments or drawing appropriate inferences from the collected data, etc. The observations of such a behaviour of the student in the teaching and learning of School Subject may label him as poor and weak in the study of the subject General Science. After potting out such a student, the teacher is bound to go deep in diagnosing the extent, nature and cause of his weaknesses and difficulties. Such diagnosis may help for thinking about some remedial measures that can be taken for removing the weakness and difficulties of the student. Remedial education or teaching in this way must

Diagnostic Testing and Remedial Teaching

be preceded by a well planned and properly carried out diagnostic testing let us try to know first about the meaning and purpose of the diagnostic testing.

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Meaning and Purpose of Diagnostic Testing

Literally diagnostic testing stands for the testing and evaluation programme carried out for the diagnosis of something. In case one has some problem regarding his physical or mental health he is subjected to one or the other kind of testing. (blood test, urine test, stress test and blood pressure, ECG, X-ray checking etc.) for diagnosing the nature as well as roots or causes of his ailments. The results of all such diagnoses then form part of the remedial or treatments programmes for helping the individual from getting rid of that physical and mental health problem. Similar is the case with the diagnostic testing and evaluation programmes carried out in the field of education. Educational efforts are aimed to bring desirable behavioural changes for and all round development in the personality of an educated. However many times these efforts may not yield the satisfactory results or the individual students may not be duly benefitted through such efforts resulting into one or the other kinds of behavioural problems or educationally failure. We are alarmed when we find student turning into a problem child or observe him lagging behind in his studies related to one or more projects of the school curriculum. Here comes the need of diagnosing his behaviour and state of educational progress in one or the other subjects of the school curriculum.

Going in this way, the need of diagnostic testing arises specifically at the time when a particular student exhibits some or the other signs and symptoms of his failure or difficulties with regard to the learning of a subject. Why is one subjected to repeated failure in the subject ? Why is he feeling difficulty in learning a particular concept or skill in one or the other branches and topics of that subject ? Why is he not attending the classes in the subject ? Why does he create fun on problems in the class ? Why does he hate the teacher of the subject ? The list may be quite exhaustive with regard to such day to day or occasional problem faced by a subject teacher with his one or more students. Surely like a physician or psychiatrist, here he has to resort to the methods of diagnosing the learning or the behavioural difficulties of his students for chalking out some remedial programmes aiming to help them in getting rid of their difficulties and problems. Looking in this way diagnosing testing in a school subject may be defined as a testing or evaluation programme carried out by a subject teacher for diagnosing the nature and extent of the learning behavioural problems of an individual or group of students along with the inherent causes for difficulties chalking

out suitable remedial programmes aimed to help them in getting rid of their difficulties and problems.

It can be easily concluded from the above discussion that diagnostic testing and remedial teaching are inter-related and complementary to each other. Each is based on and results into the other. We resort to diagnostic testing for searching the appropriate remedial measures. However, the diagnosis not followed by the remedial treatment is useless. Similarly, remedial task not based on the diagnosis of the nature and extent of the weaknesses may prove not only the wastage of the resources but can also prove dangerous to the well being of the affected persons. It is therefore, essential that diagnostic testing in a subject should necessarily be followed by the suitable remedial teaching. In fact neither diagnostic testing nor remedial teaching should ever be considered in isolation. They should form a part of a cycle known as Diagnostic testing and Remedial teaching cycle which may be considered to involve the following processes for its complete execution.

1. Diagnostic testing for knowing the child's weaknesses and learning difficulties in a particular subject.
2. Hypothesizing the probable causes for these weaknesses and difficulties.
3. Applying remedial teaching for removing these weaknesses and difficulties.
4. Evaluating the outcomes of the remedial teaching.
5. Continuing to repeat the above four processes to achieve desired success in removing the diagnosed difficulties and weaknesses.

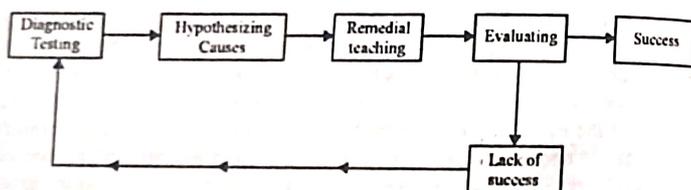


Figure 9.1. A Diagnostic Testing and Remedial Teaching Cycle.

A close analysis of the above mentioned Diagnostic testing and Remedial teaching cycle may at once reveal that here the cycle starts with the application of its first step, Diagnostic testing—testing undertaken for diagnosing the weaknesses or learning difficulties of an affected student (who has been identified so as a result of achievement tests, teachers observations, etc.) Remember here, the diagnostic testing or need of

administering diagnostic tests and other diagnosis measures arises only when something wrong and serious is reported about the progress of the child in the learning of one or the other subjects. By applying the diagnostic testing, the efforts are made to know the nature and extent of one's weaknesses and difficulties in the learning of that particular subject.

Once the weaknesses and difficulties regarding the learning of a particular concept, knowledge and skill area etc. are identified, efforts are then made to list out the probable causes responsible for these weaknesses and difficulties.

The listing of such probable causes then may be made a base for building a remediation program. The affects or outcomes of such remedial program or remedial teaching are then evaluated to see whether or not we have got desired success in getting rid of the child from his identified weaknesses or difficulties in the learning of a subject. In case we don't get the desired success indicating the ineffectiveness of the remedial teaching, then the diagnostic-remedial cycle must be re-initiated and the processes of diagnosis, hypothesizing remediation evaluation etc. must be brought into operation again for the attainment of desired success in helping the child to get rid of his learning difficulties or weaknesses in one or the other areas of the subject.

With all what has been discussed so far, one can assume that diagnostic testing and the subsequent remedial teaching is exclusively meant for the students who suffer from weaknesses or learning difficulties in one or the areas of learning a subject or those who are under achievers, slow learners, backward, learning disabled or suffer from the learning or behavioural problems with regard to the teaching-learning of a subject. However, it is not suffice as the term "diagnostic testing and remedial teaching" can be equally applied in the case of students who are gifted, creative and meritorious. Diagnosis helps in diagnosing the weaknesses as well as strengths, therefore, diagnostic testing may properly carried out for knowing what is appreciable, original, creative and above average among the genius, creative and meritorious students. Based on such diagnosis, the efforts should be made to harness their potentialities and maximise their strength for helping them further to grow and developed in the better way. Therefore, it is no harm in carrying out the diagnostic testing and remedial teaching programmes for the gifted, creative or meritorious. Rather it will be a boon for them in one or the other ways. However, as you know necessity is the mother of invention. We try only when we feel the urgency of trying. Similarly here, we resort to diagnostic testing and remedials teaching only when the necessity of doing such work is urgently felt. Since this urgency is mostly felt in the

case of those who are weak or feel difficulty in learning, the diagnostic testing and remedial teaching programmes are then usually carried out only with the students who are identified with one or the other types of learning difficulties and weaknesses in the study of one or other subjects. In the pages to follow then we will be concentrating our efforts for evolving diagnostic testing and remedial teaching strategy only for such children

Distinguishing Diagnostic Tests from the Achievement Tests

A diagnostic test is primarily carried out for knowing about the nature and extent of the learning difficulties and weaknesses of a student or group of students in a particular learning area, subject, topic or concept. Here all efforts are concentrated on the search for the areas of weaknesses (or strength in the case of above average) and error analysis (for knowing the probable causes of weaknesses) resulting into one or the other form of remedial teaching to help the needy students in getting rid of their weaknesses and learning difficulties. The search can be better made if the area and scope of this search is kept small and extensive as well as vigorous efforts are made for such search. Similar is the case with diagnosis in a particular subject. Here the task of diagnosis should be broken into simpler and smaller curriculum units and students should be asked a sufficient number of questions, preferably short answer or very short answer type including completion type objective questions for going into the depth of their areas of difficulty and weaknesses.

Achievement tests on the other hand are meant primarily to know about the level of the achievement or performance of the students with regard to their gains in the learning as a result of a process of instruction during a specified duration. We thus try to know what our students or a particular student have or has been able to achieve as a result of the on-going teaching-learning process. Where do we stand in terms of the realization of the set teaching-learning objectives? What is the level of one's achievement in comparison to the achievement of others? The answers of such questions can be properly given through the interpretation of the result of achievement tests. The item of an achievement test should then necessarily cover the entire syllabus or contents being taught.

The coverage of the contents in an achievement test may then be large and exhaustive without going into much detail and depth of the contents and the subject matter. Therefore, the results of an achievement test may tell that a particular child, stands very poor in terms of his gain or achievement in the learning of mathematics but it is unable to tell about the nature and

causes of his weakness. The specific areas of his weakness and the exact nature of his weakness along with the probable reasons can only be ascertained through specially prepared diagnostic tests. Thus the remedial instructions for removing his learning difficulties and weaknesses can only be properly planned on the basis of the results of diagnostic testing. Achievement tests can only provide a signal or warning in relation to one's poor attainment or failure.

The nature, extent and reason for such poor performance can then be properly ascertained through diagnostic testing.

With the help of what has been above said about the diagnostic and achievement tests, we can be able to distinguish them from each other in the manner given below :

1. The achievement tests while focusing on knowing about the level of the learner's achievement may only provide a hint or clue about the learning difficulty or weakness of a student, the diagnostic testing goes deeper in concluding about the nature, extent as well as reason for such learning difficulty and weakness.
2. Sampling of questions in an achievement test need detail and not to be too exhaustive to cover each and every minute points with regards to the coverage of the contents. In diagnosis on the other hand, we have to go quite in depth. Therefore, here the coverage of the subject matter is more detailed and exhaustive, though based on a smaller area than an achievement test. Diagnostic tests, have therefore, to be much longer than the achievement test to make necessary sub-tests sufficiently reliable.
3. Although the results of an achievement test may provide a signal or warning about the poor performance of a student yet these are unable to provide necessary base for the planning of a remedial programme. Diagnostic testing on the other hand necessarily leads to the formulation of a well thought remedial programme aiming to help a particular learner from getting rid of his learning difficulties and weaknesses.
4. The performance of the individual student in a diagnostic test is subjected to a careful analysis with regard to the common as well as specific error made by him for concluding about the exact nature, extent and causes of his learning difficulties and weaknesses in a particular learning area. The results of achievement tests are not subjected to such error analysis as these are primarily utilised for measuring the levels of the achievement or performance of the

students with regard to their gain in learning during a specified period.

5. In diagnostic testing we require more detailed and exhaustive content analysis / i.e. breaking of the unit into multiple learning points and then arranging these points in a hierarchical order without breaking their continuity. We can't break this continuity in case of the diagnostic test as the test in itself will become faulty by becoming unable to untouch the weaknesses of those students who are weak and deficient in respect of one or the other learning points omitted in the test. Achievement test on the other hand, do not require such type of compulsion for arranging the testing learning experiences into some hierarchical order and emphasize upon each and every learning points by maintaining their continuity in a hierarchical order.

Purposes of Diagnostic Test

1. To identify the weak areas of pupil's learning in the specific contents or subject areas of one or the other school subjects.
2. To have an early diagnosis of the problems and learning difficulties of the pupils.
3. To help the teachers to detect the defects in the learning points and instructional programme for the desired remediation.

Preparation of a Diagnostic Test

Diagnostic test needs careful planning and efforts by their designers. Usually, the following steps are needed to be followed in the construction of a diagnostic test—

- Identification of the major concepts to be developed through the instruction of a particular unit, lesson or content material.
- Analysis of the concepts in terms of the specific learning out-comes and behavioural changes.
- To become definite about the minimum expected level of performance with regard to the behavioural changes in the acquisition of knowledge and understanding, skill, application, interests, appreciations etc.
- To prepare properly graded objective type test items suiting to the concept and expected level of performance and the anticipated weaknesses, deficiencies and difficulties of the students.
- Try out of the test.
- Preparation of the final draft of the test.

Remedial Measures

Remedial measures or education involving corrective measures are to be undertaken for removing weaknesses, deficiencies and difficulties of the learner in order to obtain desired mastery level or optimum educational growth in terms of the specified learning objectives. Its aim is not confined to remove the learning difficulties and overcoming the deficiencies but to provide such congenial environment, facilities and opportunities to the learners as to develop their potentialities to the maximum.

How to take Remedial Measures ?

Remedy depends upon the diagnosis. Therefore one has to seek answer for the questions like following before planning about any remedial education :

- What is the nature, extent and level of the weaknesses, deficiencies and difficulties of the learner ?
- To which area and aspects of the subject matter, learning experiences and activities does it belong ?
- What is the cause or causes of such weakness or deficiency ?

Diagnosis about the above is thus first carried out through the diagnostic measures and then subsequent remedial programme is chalked out in the light of the result of such diagnosis. Since the weakness, deficiency, suffered and difficulties felt by the learners are usually specific and individual in nature, no general programme or scheme of remedial education applicable to all the cases, can be recommended. It is justified on the ground that problems are always varied and there are wide individual differences among the learners with regard to their abilities, capacities, interests attitudes and the nature of the difficulties felt and deficiencies suffered. Therefore in every case more stress should be laid over the correct diagnosis of the weakness, deficiency and difficulty of the individual learner. The root cause or causes of the weakness or difficulty, then should be removed or rectified with the active efforts of the teachers, learners, parents and authorities. These efforts may be of the types given ahead —

- Taking adequate steps for meeting with the problem arising out of the poor physical and mental health.
- Parental education and cooperation.
- Providing proper educational, vocational and personal guidance to the learners.
- Modifying, restructuring or introducing favourable changes in the environment available at home surroundings, schools and the society.

— Providing better education by enriching the man and material resources

In addition to the measures taken above, suitable programme selected with Remedial Teaching may also be undertaken for overcoming the weakness, deficiency and difficulties of the learners. Let us know something about such teaching.

What is Remedial teaching ?

The term remedial teaching as the name suggests stands for the teaching or instructional work carried out to provide remedial measures for helping the students (or individual student) in getting rid of their common or specific weaknesses or learning difficulties diagnosed through diagnostic testing or some other measures carried out for such diagnosis.

Diagnosis thus provides a solid base for hypothesizing the general and specific causes underlying the weaknesses or learning difficulties of the students of a class/group (or a particular student). It is thus true that as the diagnosis so is the remedy for the removal of the difficulty. Thus depending upon the general or specific nature of the weaknesses or learning difficulties of the students we have to take appropriate step for the organisation of remedial teaching for the needy students.

Organisation of Remedial teaching in General Science

Remedial teaching in one or the other subjects of the school curriculum can take various forms like below :

1. Class teaching.
2. Group tutorial teaching.
3. Individual tutorial teaching.
4. Supervised tutorial teaching.
5. Auto-instructional teaching.
6. Informal teaching.

Let us discuss now all these forms and aspects of remedial teaching.

1. Class Teaching : In this system, or schedule of remedial teaching, the usual composition and structure of the class is not disturbed. The teacher here teaches a particular lesson/unit, emphasizes a point again and again, repeats the experiments or uses some specific teaching aid in order to remove the difficulties and deficiencies of the learners in terms of the acquisition of the desired learning experiences. The class as a whole is benefited through such type of remedial teaching. It proves particularly

useful in the removal of the weakness and learning difficulties of the general nature

2. Group Tutorial Teaching : Here the students of the class are divided into some homogeneous groups called tutorial groups on the basis of their common learning difficulties and identical weaknesses or deficiencies in the acquisition of the learning experiences in some or the other areas or aspects of the subject. These groups are then taught separately by the same teacher or different teachers according to the nature of the difficulties and deficiencies. The tutor in charge of a tutorial group then tries to solve the difficulties of the learners, however, collectively on a group basis. The weak areas or aspects of the curriculum identified through diagnostic testing are properly attended by the teacher according to the needs and requirement of the pupils of the group. In case, it is related to particular work, due care and proper attention is now paid by the teacher over his own demonstration work as well as on the practical and project work done by the students in their respective groups.

The group tutorial teaching proves advantageous over the class teaching in many aspects. Here the students who have common problems and difficulties in their learning are more helped in overcoming their difficulties and deficiencies. It makes the task of teaching-learning quite interested and goal oriented in class teaching there remains a lot of chances that the time and energy of many of the students who do not suffer with a certain learning deficiency or difficulty will go in vain by attending to the remedial teaching not at all needed by them. Moreover, the number of students in group tutorial teaching is comparatively reduced. It results in making the task of the teaching more convenient, and effective for providing better coaching and practice in terms of the needed remedial education.

3. Individual Tutorial Teaching : In this schedule every learner, who feels learning difficulty of one or the other nature, is attended individually for overcoming his deficiencies or weakness. It is one to one coaching, help and guidance that is rendered by the teacher to the learner as and when needed by him in order to actualize his potentialities to the maximum. Therefore in this type of remedial teaching, maximum consideration may be provided to the principle of individual difference in the direction of the best results in the task of teaching and learning. Here the students may progress according to their own pace, abilities and capacities and get adequate help, individual attention and reinforcement for coping up with their deficiencies and difficulties on the path of learning.

4. Supervised Tutorial Teaching : In this schedule of remedial teaching the responsibility of overcoming the learning difficulties and removing deficiencies in some learning areas is handed over to the learners themselves. They have to work at their own for removing their difficulties and deficiencies. The role of the teacher is confined to observe and supervise the learning activities and provide as much help as necessary to carry on them on their path of self learning and self correction. This type of supervision can be made on the individual as well as tutorial group levels. The students may opt to work in the group or individually for solving their difficulties and over coming their learning deficiencies.

5. Auto-Instructional Teaching : This type of remedial teaching consists of auto-instructional programmes and activities. Here the learner is provided with basic auto-instructional and self-learning material and equipments like programmed learning text books and packages, auto-learning modules, teaching machines and computer assisted programmed instructions etc. This material helps the pupil to gain sufficient practice and drill work in the areas of his weakness and acquire necessary confidence in overcoming his difficulties and deficiencies through well programmed self-instructional material.

6. Informal Teaching : Informal education and teaching suitably planned and assimilated with the formal education of the school may go in a big way to act as a source and means of remedial education to the needy students. The activities connected with such informal education in the form of excursions or trips, collecting material for the school museum, improvising apparatus, working on useful projects, engaging in the useful hobbies, establishing aquarium, vivarium, terrarium, botanical garden, zoo and nature study corner in the school campus and participating in the subject club activities, etc. make the study of school a joyful event. These activities suit the diversified interests of the students and provide unique and special opportunities to learn and practise the facts and principles of school subjects. The learning difficulties raised out of the lack of interest, non-availability of direct and first hand learning experiences, deficiencies in the methodology of teaching, psychological needs and problems of the learners and host of other reasons may be easily overcome through the organisation of useful non-formal activities of various interests in the schools.

A. ESSAY TYPE QUESTIONS

1. Explain in detail the meaning and purpose of diagnostic testing.
2. What are diagnostic tests? How do they differ from achievement tests? Explain.
3. What is diagnostic testing? Outline the process of the construction of a diagnostic test in a school subject.
4. "Diagnosis is the pre-requisite for any remedial programme in education". Discuss the functions of diagnosis in planning for the remedial teaching to the students.
5. What is remedial teaching? Why is it essential on the part of teacher to plan for such teaching? Discuss in detail.
6. Discuss the different types of remedial teaching that can be undertaken by a teacher to overcome the deficiencies, weaknesses and difficulties of his student in his subject.
7. Discuss in brief the remedial measures that can be suggested for overcoming the weaknesses and difficulties faced by a student in the learning of concepts and principles in one or the other school subjects.

B. SHORT ANSWER TYPE QUESTIONS

1. What is diagnostic testing?
2. What is remedial teaching?
3. Name two purposes of diagnostic testing.
4. Name the different forms employed for the organisation of remedial teaching.

Using ICT in Examination

CHAPTER OUTLINE

- Introduction
- Meaning of Information and Communication Technology (ICT)
- Origin and Growth of ICT
- The Traditional and Modern ICT's
- Using ICT in Examination – Administration and Execution
- Study Questions

Introduction

Today we are living in such a knowledge based society, and knowledge based global world where knowledge is a great power, economy and strength of an individual and the asset of a nation. It is also true that there is tremendous explosion in its quality as well as its growth. We are in need of new technologies to have access and proper use of this fast growing knowledge. Moreover a mere acquisition of knowledge is not enough, we must have a complete access and mastery over the knowledge getting process. It can only happen with the assistance of the science of information and communication technology. In the present chapter we would be learning some essentials about the nature and use of Information and communication technology (shortly designated as ICT).

Meaning of Information and Communication Technology (ICT)

Experience is said to be a great teacher. This experience may be gained by the learner through direct and indirect means. The direct assess to the source for gaining first hand experience is neither always possible nor desirable. Consequently, most of our learning is based on second hand experiences in the form of information received by us about the objects, places, persons, ideas or events. This information provides a base for our knowledge and understanding about them and the environment surrounding them. For this purpose the learner must be able to learn the art of getting

Using ICT in Examination

information, store and make its use as and when desired. Such type of activities concerning information are said to be the part and parcel of the science and technology known as the information technology. However, the use of such information as well as access to such information remain incomplete without the involvement of the art of communication. Communication as a two way process stands for the sharing of ideas, thoughts, beliefs and information with others. The mutual sharing between the source of information and receiver of the information, that leads to the increase, understanding and use of information, that used to add in building up knowledge. In this way both information as well as communication are utmost needed in acquiring knowledge as well as involve in the knowledge acquiring process. Now in case we want to have efficiency and effectiveness in the activities related to information and communication, we will have to take help from the science and technology of information and communication better known as information and communication technology or ICT. In this way information and communication technology is that type of technology employed in the shape of tools, equipments and application support which helps in the collection, storage, retrieval, use, transmission, manipulation and dissemination of information as accurately and efficiently as possible for the purpose of enriching the knowledge and develop communication, decision making as well as problem solving ability of the user.

Origin and Growth of Information and Communication Technology (ICT)

Communicating as well as collecting information and using them for the specific purpose is as old as the human civilization itself. In the absence of the means and tools for information and communication the primitive way was to carryout them orally, store them in the memory and transmit them orally to the user. In this way invention of paper and ink must be regarded as the first breakthrough in the field of information and communication technology (ICT). The other scientific inventions which provided better means for this purpose may be named as movable type (invented by Gutenberg in 1438 A.D. in Germany). Print media has also helped a lot in the development of ICT. The advanced technological development, helping in the task of ICT may be outlined as below :

- Photography in 1849 by a Frenchman L.G.M. Daguerre and an Englishman W.H.R Talbot
- Photostat in 1900, by Professor Abbe Rene Graffin of France.
- Xerography invented in 1938 by Chester F Carlson of U.S.A.

- Micrography (obtaining copies of the recorded material in highly reduced format) invented in 1940 by an Englishman J.B. Dancer and Frenchman Rene Dagan.
- Laser technology used for printing and memory device in 1960 by Theodore Maiman of U.S.A.
- Magnetic video camera, video disc and computers developed in 20th century.

Besides this, the advancement in the field of telecommunication technology has contributed a lot in the evolution of ICT. Starting from the era of sending messages through pigeons, we have reached the age of Satellite Communication. The land marks in such development can be cited as below :

- Telegraph invented by S.F.B. Morse of U.S.A. in 1837.
- Telephone invented by Alexander Graham Bell of Scotland in 1876.
- Radio invented by G. Marconi of Italy in 1895. Television invented by J.L. Baird of Scotland in 1925.
- Development of communication satellites (first Satellite Sputnik was launched by U.S.S.R. on 4th Oct. 1957) and cable and facsimile transmission (Fax) technology in the 20th century.

Equipped with the modern invention in the field of collection, storage, retrieval and transmission and exchange of information, the serious attempts in the direction of exercising scientific control over the process of information and communication was introduced in the later half of the 19th century. The credit goes to U.S.A. where the term "information science" (later called as information and communication technology) was first introduced in 1950 for the effective handling of the interchange of scientific information among the scientists in U.S.A. and foreign countries. The objects of such information science services were as under :

- (i) To provide or arrange for the provision of indexing, abstracting, translating and other services leading to a more effective dissemination of scientific information.
- (ii) To undertake programmes to develop new and improved methods including mechanised systems for making scientific information available to the users.

Initially, the thrust of the ICT was primarily focused on the handling of bibliographic records and textual information in the scientific sector. Later on, around 1960, it was also applied in the field of industry. At this stage computer-aided techniques and systems were developed for more efficient information and communication purposes. In the later years-the

use and application of ICT could not remain limited to the field of science and industry but gradually got broadened to encompass other fields of operation. areas and professions like banking, management, education, medicine and health care, government offices, law and, judiciary, the police and military establishment and what not. As a result today we are making its use now in our classroom teaching-learning, distance and on line education, establishing virtual classrooms and thus harnessing its power as an effective tool and media of formal, informal and non-formal education as well as quite reliable helping hand for the welfare and progress of the growing children of the country.

The Traditional and Modern Information and Communication Technologies (ICTs)

Information and communication technologies as we can visualize through the previous discussion are in vogue from the olden days. These can be classified as traditional and modern. Both of these traditional and modern technologies may be found to include the tools, equipment and support material for the purpose of information and communication in the manner given below :

1. Traditional Information and Communication Technologies :

These technologies may include the means and media like below :

- Printed media in the form of text books, resource books, journals, news items and other literature available in the school and public libraries.
- The verbal information and ideas exchanged with peers, teachers, parents and other members of the society.
- The graphical aid material like pictures, charts, maps, diagrams, posters and cartoons etc.
- The three dimensional aid material like specimen, model, puppetry, mock up etc.
- The audio visual hardware equipments like radio, television, slide projectors, overhead projectors, motion pictures, tap recorder, audio-video recording device and teaching machines etc.

2. The Modern Information and Communication Technologies :

The modern IC technologies are not single technologies like the traditional technologies. They are a combination of hardware and software, media and delivery systems. In addition they have also gone digital. Some of these may be named as below :

- Digital video camera

- Multimedia personal computer (PC), Laptop and note book
- Application software such as word processing, spread sheets, Power point, simulation and speed recognition
- Multimedia projector (LCD or DLP) to communicate large group
- Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN)
- Multimedia PC/Laptop with video card and web camera or digital video camera
- Computer Data base and Data processing mechanism, CD ROM and DVD
- Digital libraries
- E. mail, Internet and World Wide Website (WWW)
- Hyper media and Hyper text Resources
- Computer Mediated Conferencing-Video and Audio Conferencing
- Video text, tele text, Interactive Video text, Interactive Video disk (IVD) and Interactive Remote Instruction (IRI)
- The idea of Virtual classroom and virtual reality.

Using ICT for the Administration and Execution of Examination

Information and communication technology (ICT) can be effectively used for carrying out the task of examination particularly in the matter related to its administration and execution. Let us think, how ?

1. **Construction of a unique test or question paper :** The administration and execution of an examination urgently needs the development of a test or question paper for assessing or evaluating the learning outcomes of the student in one or the other curricular subjects. Here the use of ICT render valuable help for generating an appropriate set of question paper with the use of a suitable application software and available question banks. In the case of a need (such as setting question paper for on-Demand Examination, entrance eligibility, selection or promotion test), use of ICT is helpful in generating multiple set of question papers each unique in themselves in perfect tune with the design and blue print suggested for the purpose. Since questions are taken randomly from the question bank, no two set of question papers are same or repeated and thus may prove quite functionable in checking the cases of cheating and fraud in the examination.

2. **Development of Question banks for the different curricular subjects :** Examiners and paper setters need appropriate questions for setting

Using ICT in Examination

the question papers. The selection of suitable items for a question paper helpful in the testing or assessment of behavioural outcomes in each domain and specified objectives such as knowledge, understanding, application, skill interest, attitudes and appreciation is a quite tedious task. There should be appropriate question banks for this purpose and the development of such question banks with their safe storage and application can be very effectively done through the use of ICT.

3. **Administration of a test or mode of examination :** ICT services can be effectively utilized for the administration of a test or mode of examination to the intended examinees of unlimited numbers appearing at a number of examination centers located at the various corners of a region or globe. Use of ICT can help in meeting the demands of on-line examinations, examination on-demand as well as the usual face to face real space and location examination. All the tasks related to the administration of on-line examinations are carried out with the use of ICT in a quite effective and convenient ways. In the case of face to face real space and location examination, the tasks related to administration, supervision and collection of answer books of the students including a close vision on the cases of fraud and cheating can be effectively performed through the use of suitable ICT services.

4. **Scoring of the test responses :** Scoring of the responses to the test questions of an examination can be done in two different ways - manual and electronic. In both, we need the help of a marking scheme or scoring key. The use of ICT can help in developing such a scheme or key in a quite proper way. The marking scheme or scoring key is compiled for each set of the questions papers used in examination on-demand and on-line examinations and this task can be quite competently performed with the use of ICT. As far as the task related to electronic scoring is concerned, use of ICT can facilitate it in a quite easy and automatic way. In the case of computer based on-line examination, the help of a suitable software can be taken for the task of analysing and scoring of the responses/work performances of the students submitted on-line to the examiner or test administration centre.

In the case of usual face to face real location examination, the compiled answer sheets of the students can be subjected to ICT based electronic scoring. Not only the responses to multiple choice objective type test items but also the responses to short answer type and essay type questions can be appropriately assessed and marked with the help of suitably developed software and rubrics related evaluation. In this way use of ICT can help in a proper way for carrying out the scoring of the test responses.

5. **Interpretation of the test responses :** The results obtained through the application of tools and techniques in examination (*i.e.* scores on the achievement tests) can be treated well with the use of ICT for their needed interpretation and derivation of useful meaning out of them. Accordingly, test scores or data derived from assessment tools is first stored and tabulated in a proper way with the use of ICT based statistical techniques and then subjected to proper data analysis with the use of the needed software. We can compute various statistics like mean, median, mode, standard deviation, correlation coefficients, percentages, percentile and percentile rank with the use of the sophisticated techniques available through ICT. The various graphs in the form of histogram, frequency polygon, ogive etc. can also be drawn through the use of computer aided exercises for presenting a useful interpretation of the test results. The higher order data analysis (quantitative as well as qualitative) can also be carried out with the use of now commonly available software packages. In addition the task of reporting the test results can also be appropriately and conveniently performed with the use of ICT. Computation of merit positions and divisions, expression of numerical marking in the specific grades, computation of credit points, preparation of award sheets and transcripts report cards and cumulative record cards all can be properly, easily and automatically possible through the use of ICT.

In this way all the needed activities related to the administration and execution of the needed tasks related to examination can be properly performed through the use of ICT. What we know as the latest development and innovations in the system of examination such as computer based on-line examination, examination on-demand, the establishment of question banks and their proper utilization, adopting school based credit system and using alternative modes of examination can be properly facilitated as well as executed with the use of ICT.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. While throwing light on the meaning of information and communication technology (ICT), trace its origin and growth in a proper way.
2. What are traditional and modern information and communication technologies (ICTs)? Name them in brief.
3. Discuss in detail how ICT can be employed for the administration and execution of the examination related activities.

B. SHORT ANSWER TYPE QUESTIONS

1. What is information and communication technology (ICT)?
2. Name any five traditional means of ICT.
3. Name any six modern means of ICT.
4. Tell in brief how ICT can be employed for any one of the following tasks related to administration and execution of examination.
 - (a) Setting of question paper
 - (b) Scoring of the responses
 - (c) Developing a question bank
 - (d) analysis and interpretation of achievement scores

Issues in Assessment

CHAPTER OUTLINE

- Introduction
- Assessment at Different Stages
- Design and Conduct of Assessment
- Curricular Areas that can't be tested for marks
- Study Questions

Introduction

As we know teaching-learning process is comprised of the four essential elements or components, namely: (i) the setting of teaching-learning or instructional objectives (ii) selecting and organizing learning experiences for the attainment of these objectives in the name of curriculum planning, (iii) using appropriate methods and devices for helping students in the acquisition of these learning experience and (iv) getting acquainted with the progress of the efforts made in the realization of instructional objectives through the planned learning experiences and methods utilized for their gaining. The fourth one, known as evaluation or assessment is known as the controlling key of the teaching-learning process as it helps in knowing the strengths and weaknesses of the efforts made in the setting of objectives and delivery of the contents and learning experiences for the realization of the set objectives. Realising its unique position the curriculum developers always care for mentioning the needed evaluation or assessment measures for the implementation of their developed curriculum in a proper way. The developers of National Curriculum Frame Work-2005 have also tried to mention about the needed aspects and dimensions of assessment or evaluation in their published documents in a quite satisfactory way. We have already discussed their vision of assessment for learning in the chapter two of this text. In their discussion, the curriculum developers have highlighted certain issues related to the assessment of students' learning outcomes such as (i) assessment at different stages (ii) design and conduct of assessment and (iii) curricular areas that can't be tested for marks. Here in this chapter, we would like to focus our attention for getting acquainted well with the nature

Issues in Assessment

of these issues with an attempt of finding some ways for their satisfactory resolution

A. Assessment at Different Stages

What to assess depends upon the type of behavioural changes expected from the learners as a result of the ongoing teaching-learning process. In turn what is expected from the learners depends upon the teaching-learning or instructional objectives set for them in view of their learning needs, level of maturity, characteristics and features related to their developmental age and environmental demands.

In fact what should be taught or learned by the children and how should it be taught or learned, decision in this regard rests very much on the age, and maturity level attained in terms of their physical, mental, emotional and social development. Since what should be evaluated, depends very much on what is to be taught and learned on the part of children, the nature and scope of assessment as well as the modes and forms of methods utilized or this assessment differs from stage to stage of their development. What is true for the assessment at the earlier stages of their education can't fit well for the assessment needed at the later subsequent stages. Let us see what type of assessment is needed at the different stages of school education for the developing children.

1. Upto class II of the Elementary Stage : It is the pre-childhood and early childhood stage of the children's development. This stage is full of activities and playing spirit rules the behaviour of the children. No serious attempts or providing curricular experiences are then made for the education of the children at this stage. The attention focuses on helping them to go well in terms of their health and physical development, learn social and communication skills for interacting with each other and adjust in their social environment, and engage in the constructive and creative activities much suited to their cognitive development and play way spirit. Following the basic rule that set in terms of teaching-learning objectives and what happens in terms of teaching-learning at a particular developmental or school education stage should invariably decide the nature and mode of carrying any assessment of the learning and behavioural outcomes of the children, NCF-2005 has proposed the following things in this regard.

- Children's activities in various domains (physical, cognitive, social, emotional, constructive and creative, artistic and play way) as well as the status of their health and physical development should be made the subject of their assessment.
- Assessment should not involve the testing devices (oral or written). Instead, non-testing devices more commonly the observation of their

behaviour and activities in a spontaneous way should be utilised as a tool for their needed assessment of their progress and development.

- (iii) Qualitative assessment mode should be adopted instead of the quantitative assessment mode for knowing about the expected changes in their behavioural domains.

2. From class III to class VIII of the Elementary Stage : The children of this school stage usually belong to the age group of 8 years to 13 years covering the childhood and pre-adolescence period of their growth and development. Here the students are expected to get engaged in the learning of curricular subjects in a more formal and organized way. They also are likely to get enhanced in terms of the use of their communication and social skills as well as experimentation with concrete objects and real life situations to learn and apply the things in one way or the other. The evaluation or assessment of their learning and behavioural outcomes at this stage in the light of the suggestions put forward by NCF-2005, needs the caring of the things like below:

- (i) Testing as well as non-testing devices of varying nature can be used as a tool for assessing the learning and behavioural outcomes of the student. It may include the use of oral and written tests, use of observation, rating scale, checklist and other activities and performance based assessment techniques.
- (ii) Under no circumstances, the testing or assessment of the students should be allowed to become a thing of fear and over-loaded anxiety for them. The evaluation or assessment should be viewed by them as a part of their teaching-learning helpful in caring for their performance, learning difficulties and behavioural improvement.
- (iii) Both qualitative as well as quantitative modes of assessment should be practiced for the needed evaluation.
- (iv) Emphasis should also be laid over self-assessment and group work assessment.
- (v) Formative evaluation in the form of short tests from time to time should be preferred much at this stage in place of the long duration periodical or terminal examinations. Term wise examination may be introduced from class VII onwards. When children are found to be more prepared physically as well as mentally in spending long hours in an examination hall for answering the questions of the periodical examinations.
- (vi) The reports cards of the students should be prepared well in time for providing needed feedback to the students as well as their parents. In report cards, there should be entry of grade and marks alongwith qualitative description of the progress of the performance of the

students in the scholastic as well as non-scholastic areas. It should also mention the things that need to be cared on the part of parents for the desired progress and welfare of the children.

3. Class IX to class XII of the Secondary and Higher Secondary Stage : The children of this school stage generally belong to the age group of 14 years to 17 years known as the age of adolescence in the journey of growth and development of the children. The students belonging to this developmental period are so matured as to take up serious study of the curricular subjects alongwith their varied interests and capabilities to take part in various types of co-curricular and non-scholastic activities. They have the capacity to think and reason in a more conceptual and abstract way. They are more mature and capable in terms of their physical, mental, social, emotional and aesthetic development. They have a quite developed creative, constructive and imaginative faculties with a lot of energy to do and struggle. Keeping in view of the nature of the learners of this age and expectations from them in view of the objectives set for the education at the secondary and higher secondary stages, the assessment of the learning and behavioural outcomes of the students needs to be quite different than employed at the earlier stages of school education. Taking clue from the suggestions put forward by NCF-2005 for the assessment of the children belonging to this school education stage, we can point out the following things for the better organization of assessment programs for the learners of this developmental and educational period.

- (i) There is a need of the adoption of the continuous and comprehensive evaluation (CCE) scheme for the needed assessment, feedback, development and progress of the students.
- (ii) A variety of testing and non-testing devices, assessment tools and techniques should be employed depending upon the assessment needs in one or the other teaching-learning situation in a quite synthesized and integrated way for drawing a reliable and valid portrait of the students' achievement and progress from time to time.
- (iii) As the need arises a variety of evaluation formats such as formative evaluation, diagnostic evaluation, summative evaluation, criterion or norm reference evaluation should be used for the assessment of the learning and behavioural outcomes of the students.
- (iv) Alternative modes of assessment other than usual classroom paper-pencil, oral written and practical examinations should be adopted for the assessment at this stage. Accordingly we may make use of seminar presentation, quiz competition, project reports, port folios, constructive and creative output, psychological tests, sociometric techniques etc. for the judgement of the progress of the students in

the different behavioural domains, as well as scholastic and non-scholastic areas.

- (v) More emphasis should be placed on self-assessment, peer assessment, internal assessment and group or cooperative work assessment.
- (vi) Attempts can be made to test the use and applicability of the based school assessment, on-demand assessment, computer based on-line examination etc.
- (vii) Parents should be actively involved in deriving useful benefits from the feedback of the assessment outcomes. There should be a proper valid system of preparing and communicating the report to the students about their continual and comprehensive progress, strengths and weaknesses, deficiencies as well as expectations so that parents and students themselves may draw necessary information and feedback for getting properly benefitted through the assessment outcomes.

B. Design and Conduct of Assessment

Any plan or scheme of assessment is primarily aimed to provide desired feedback about the nature of the learning or behavioural outcomes of the students in tune with the objectives set for their teaching-learning at different developmental stages of school education. However, it can serve its purpose well only when a proper care is taken for its adequate designing alongwith the necessary measures for its use and application. Let us see what can be done on both of these fronts.

Designing of the assessment

Proper attention should be paid for drawing out a scheme, plan, tool method or process of assessment used for assessing the learning or behavioural outcomes of the learners in a given teaching-learning situation. The things like below may help the teacher for designing and preparing a well thought assessment program.

- (i) For what the designed assessment program stands for, should be very clear to the assessment designer. In case one does not know the real purposes or objectives served through the assessment, he is not expected to offer a well designed assessment program or measure for serving the desired purposes in a teaching-learning situation. What type of behavioural changes are expected from the learners should always be taken as a base or starting point for designing an assessment program or tool.
- (ii) In addition to paying attention towards the realization of set objectives, the assessment designer or developer should also take into consideration the type of learning experiences made available to the

learners for the realization of the set objectives in a teaching-learning situation.

- (iii) A due attention should be paid over the appropriate selection of tools, techniques, devices and methods utilized for the assessment of the learning and behavioural outcomes of the students. Here it needs to be seen that what is the focus or purpose of the assessment? Does it need to assess the outcomes related to cognitive/affective/psychomotor or non-scholastic areas and in that areas also what is the nature and scope of our assessment? Taking into such consideration a proper selection of the tools/techniques of assessment must be taken.
- (iv) The appropriateness of the tool used for assessment in terms of reliability, validity, objectivity, comprehensiveness, appropriateness with respect to its, use and administration etc. should be well ensured by the assessment designer or developer.
- (v) The alternative ways and measures for the assessment of learning or behavioural changes need to be adopted and planned in a proper way. Mentionable are open book examination, on-demand examination, computer based on-line examination, self-assessment, peer assessment and group based common assessment etc.

In addition to what has been said about the planning and designing of the assessment measures, the views expressed in NCF-2005 on this account are also worth functioning. Let us reproduce them here for the needed benefit.

- (a) Assessment and examination must be credible and based on valid way of gauging learning.
- (b) Tests in knowledge-based subject areas must be able to gauge what children have learnt, and their ability to use this knowledge for problem solving and application in the real world. In addition, they must also be able to test the processes of thinking to gauge if the learner has also learnt where to find information, how to use new information, and to analyse and evaluate the same.
- (c) The type of questions that are set for assessment need to go beyond what is given in the book. Often children's learning is restricted as teachers do not accept their answers if they are different from what is presented in the guidebooks. Questions that are open-ended and challenging could also be used. Designing good test items and questions is an art, and teachers should spend time thinking about and devising such questions. The interest and ability of teachers to design good questions can be promoted through district-or state-level competitions. All question papers must be designed graded for difficulty in order to permit all children to experience a level of

success, and to gain confidence in their ability to answer and solve problems

Conduct of Assessment

A proper attention over the procedure of conducting the assessment program or measure is also quite vital for getting desired success in attaining the purposes or objectives of assessment in one or the other teaching-learning situation. For this purpose, the things like below should be kept in mind.

- (i) The students should be fully aware of the purpose of assessment and the ways and procedure of getting assessed at the hands of examiners and evaluators on the individual or collective basis.
- (ii) The assessment measures should be so used as to provide needed feedback and intrinsic motivation to the progress of students instead of breeding unhealthy competitions and rivalry among them.
- (iii) In the administration, scoring and interpretation of the tests or other assessment measure sufficient care should be taken for the credibility of these measures. Attempts should be properly made for maintaining secrecy of the question papers or items of the assessment tools, maintaining a healthy and congenial environment of the place of holding test or examination and restraining the cases of cheating and fraud on the part of examinees.
- (iv) For controlling the menace of copying and cheating the idea of implementing the system of open book examination should be given a trial at all levels of school examination.
- (v) In addition to paying proper attention towards the conduct of tests and examination, a due care should always be taken for making the conduct of oral, practical, laboratory, workshop, projects, portfolios and performance based assessment programs and measures as credible as possible.
- (vi) Proper attention should be paid over utilising the outcomes of the measures of self-evaluation and peer evaluation.

C. Curricular Areas that cannot be 'tested for marks'

In the school curriculum there remains appropriate provision of providing needed learning experiences to the students for bringing wholesome or holistic development in their personality and dimensions of behaviour. The extent to which this objective or attempt for doing so on the part of teachers and learners have been realized the measures of assessment or evaluation are always designed and conducted for targeting this objective. The assessment measures utilized for assessing the learning outcomes of the curricular areas (subjects of the school curriculum) mostly in general yield the quantitative information or data in the form of achievement/

performance scores or marks. However, it does not mean that all the areas and aspects of school curriculum can be subjected to such assessment techniques, tools and measures yielding numerical scores or marks i.e. subjected to quantitative assessment. There are a number of curricular areas and learning experiences provided to the students for the assessment of which quantitative assessment is neither suitable nor possible in one or the other aspects. Such areas can be located easily in the subjects health and physical education, yoga, arts and painting, work experiences and socially useful productive work, music, dance, dramatics and other activities related to creative and constructive expression. Similarly, the changes brought out in the affective behaviour such as related to changes in attitudes, interests, appreciation, habits and temperament, personality traits etc cannot be appropriately expressed or interpreted well through the use of quantitative measures of assessment. We need qualitative descriptors instead of expressing their assessment outcomes in the form of numerical scores, marks or other quantitative description. It means that due emphasis should be given for using qualitative assessment measures for the subjects and activities related to school curriculum that cannot be tested for marks (i.e. non-suitable for quantitative assessment).

These qualitative measures of the assessment may involve the non-testing devices and tools like observation, rating scale, interview, checklist, personality tests, portfolio assessment, anecdotal record, seminar presentation, project reports, journals and profiles, diary writing, assessment of performance related activities etc.

However, with a lack of knowledge and skills in the use of qualitative measures on the part of the teachers as well as the excuse of finding little time or resources for the use of these techniques have resulted in the neglect of these curricular areas. It needs to be stopped. Expressing views on this phenomenon NCF-2005 (p. 73-74) has remarked in the manner like below

Each area of the curriculum may not lend itself to being tested, it may even be antithetical to the nature of learning in the curricular area. This includes areas such as work, health, yoga, physical education, music and art. While the skill-based component of physical education and yoga could be tested, the health aspect needs continuous and qualitative assessments. Currently, this has the effect of making these subjects and activities 'less important' in the curriculum; these areas are inadequately provided for in terms of material resources and curricular planning, and marked by a lack of seriousness. Further, the time allocated for them is also frequently sacrificed to accommodate special classes. This is a serious compromise with parts of the curriculum that have deep educational significance and potential. Even if 'marks' cannot be given, children can be assessed for

their development in these areas. Participation, interest, and level of involvement, and the extent to which abilities and skills have been honed, are some markers that can help teachers to gauge the benefits of what children learn and gain through such activities. Asking children to self report on their learning can also provide teachers with insight into children's educational progress and give them feedback on improving curriculum or pedagogy.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. Assessment of learning outcomes of the children differs from one stage to another stage of school education. Throw light on this aspect by highlighting the nature of assessment carried out at the different developmental as well as school education stages.
2. Assessment for serving its desired ends should be properly designed and conducted well on proper lines. Throw light on this aspect of assessment in a proper way.
3. There are a number of curricular areas that cannot be tested for marks. For illustration name these areas and suggest measures for carrying out the assessment task for these areas.
4. Provide the views and comments given in NCF-2005 for highlighting the issues related to the following aspects of students' assessment.
 - (a) Assessment at different stages
 - (b) Design and conduct of assessment
 - (c) Curricular areas that cannot be tested for marks.

B. SHORT ANSWER TYPE QUESTIONS

1. Tell a few important things related to assessment at one of the following stages of school education.
 - (a) Upto class II of the elementary stage
 - (b) From class III to class VIII of the elementary stage
 - (c) From class IX to class XII of the secondary and Higher secondary stage.
2. Tell two things each for the proper designing and conduct of assessment.
3. Name five curricular areas that cannot be tested for marks.
4. Name five assessment measures or tools that can be used for assessing the curricular areas that cannot be tested for marks.

Statistics in Educational Assessment

CHAPTER OUTLINE

- Meaning of Statistics
- Need and Importance of Statistics in Educational Assessment
- Study Questions

Meaning of Statistics

Usually the word statistics carries the following three common meanings :

1. In the first place, it refers to numerical facts. State as well as Central, Statistical department and various other agencies can be seen engaged in collecting valuable statistics (numerical facts) concerning the Birth and death, School attendance, Employment market, Output of Industrial plants and Agriculture fields etc.

2. As a second meaning, the word statistics refers to the method or methods of dealing with numerical facts. In this sense statistics is taken as science of collecting, classifying, summarizing, analysing and interpreting of numerical facts.

3. In its third meaning statistics refers to the summarized figures of numerical facts such as percentages, averages, means, medians, modes, standard deviations etc. Each of these figures separately. (average or mean etc.) is referred to as 'Statistics'.

In this way the word statistics can be referred to numerical facts or science or methodology of dealing with numerical facts or summarized figures of numerical facts. Tate (1955 : 5) has beautifully summarized these different meanings of the word statistics in the following witty comments, "It's all perfectly clear : you compute statistics (mean, median, mode etc.) from statistics (numerical facts) by statistics (statistics as a science or methodology)."

It is all about the different meanings that can be attached to the word 'statistics'. But in general sense as a subject or branch of knowledge statistics is defined as *one of the subjects of study that helps us in the scientific collection, presentation, analysis and interpretation of numerical facts*

Need and Importance of Statistics in Educational Assessment

Statistics, in general, renders valuable services in the following dimensions :

- In the collection of evidence or facts (numerical or otherwise)
- In the classification, organisation and summarization of numerical facts.
- In drawing general conclusions and inferences or making predictions on the basis of particular facts and evidences.

On account of the above mentioned services statistics is now regarded as an indispensable instrument in the field of Educational assessment. Especially where any sort of measurement or evaluation is involved the need in Education can be summarized as below :—

1. In the construction and standardization of various tests and measures. Statistical methods help in the construction and standardization of various tests and measures like Achievement tests in various subjects, Intelligence tests, Aptitude tests, Interest Inventories, Attitude Scales and various other measures of personality assessment.

2. In making proper use of the results of various tests and measures. Scores obtained from various tests and measures are always relative and not absolute. Hence they are meaningless in themselves. Statistical methods help in their proper presentation, comparison and interpretation. This service rendered by statistics help us :—

- to know individual differences of our students,
- to render guidance to the students,
- to compare the suitability of one method or technique over the other,
- to compare the results of one system of evaluation with the other,
- to compare the function and working of one institution with the other,
- to make prediction regarding the future progress of the students,
- to make selection, classification and promotion of the students,
- to keep various types of records and furnish Educational statistics etc.

By the above services of statistics in Educational assessment, it can be easily concluded that it is very helpful to the teachers in the proper

functioning of their various duties. It gives a definite direction of the process of teaching and learning and helps the teacher to realise the broader aims and objectives of education. By its increasing popularity in Psychological as well as educational researches, it is now going to be most indispensable to every teacher. Its knowledge not only helps a teacher in acquainting with the new innovations and researches in the field of education but also prepares him to become an active participant in introducing as well as bringing changes in the field of Education.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

- While explaining the meaning of the term statistics throw light on the need and importance of this subject in educational assessment.
- What is statistics? Why should a teacher know about it? Explain with examples.
- Write a detailed note about the significance of the subject statistics in the field of Educational assessment.

B. SHORT ANSWER TYPE QUESTIONS

- Define the term Statistics.
- Define the term 'Educational Statistics'.
- Write four things reflecting the significance of the subject statistics in the field of educational assessment.

Organisation and Graphical Presentation of Data

CHAPTER OUTLINE

- The Meaning of term 'Data'
- Methods of Organising and Presenting Data
 - Tabulation
 - Frequency Distribution
 - Graphical Representation of Ungrouped Data (Pictograph, Bargraph, Piegraphs and Line Graphs)
 - Graphical Representation of Grouped Data (Histogram, Frequency Polygon, Cumulative Frequency Curve and Ogive)
- Study Questions

The Meaning of Term Data

The dictionary meaning of the word data is facts (plural of datum, meaning fact). Thus, in wider sense the term data designates the evidence or facts for describing a group or a situation, but in a particular sense it is generally used for numerical facts such as heights, weights, scores on achievement tests and intelligence tests etc.

Methods of Organising and Presenting Data

The data from tests and experiments in the form of scores need to be classified and organised in a systematic way for understanding the meaning and deriving some useful conclusions. In general the following four methods are used for organising and presenting statistical data :—

- A. Presentation in the form of Statistical Tables.
- B. Presentation in the form of Frequency Distribution.
- C. Graphical presentation of ungrouped data.
- D. Graphical presentation of Frequency distribution (Grouped data)

Organisation and Graphical Presentation of Data

A. Statistical Tables

In this form of presentation, the data are tabulated or arranged in some properly selected classes, and the arrangement is described by title and sub-titles. Such tables can list the original raw scores as well as the percentages, means, standard deviations etc. Below we give a sketch of table for illustration.

Table 13.1
Pass percentages of High Schools of
Rohtak City in the High School Public Examination

	Name of the School	Pass percentage	Girls Pass percentages	Boys Pass percentages
High Schools of Rohtak	A			
	B			
	C			
	D			
	E			

B. Frequency Distribution

In this form of presentation, we group the quantitative data into some arbitrarily chosen classes. For this purpose, usually, the scores are distributed into groups of scores (classes) and each score is allotted a place in the respective group or class. It is also seen how many times a particular score or group of scores occurs in the given data. This is known as the frequency of a score or group of scores. In this way, *Frequency distribution may be considered as a method of presenting a collection of groups of scores in such a way as to show the frequency in each group of scores or class*. Various steps for presenting quantitative data by a frequency distribution can be understood properly with the help of the following example :—

Example 12.1. The marks obtained by 50 students in an Achievement test are given below :—

62, 21, 26, 32, 56, 36, 37, 39, 53, 40, 54, 42
44, 61, 68, 28, 33, 56, 57, 37, 52, 39, 40, 54
43, 43, 63, 30, 34, 58, 35, 38, 50, 38, 52, 41
51, 44, 41, 42, 43, 45, 46, 45, 47, 48, 49, 45
46, 48.

Tabulate these scores in a Frequency distribution by clearly explaining

Steps for grouping data into Frequency Distribution.

1. Finding the range. First of all the range of the series to be grouped is found out. It is done by subtracting the lowest score from the highest. In this present problem the range of the distribution is $68-21$ i.e. 47.

2. To determine the class interval or grouping interval. After finding out the range, the number and size of the classes or groups to be used in grouping the data are decided.

There exists two different rules for this purpose.

First Rule. For gaining an idea of the size of the classes i.e. class interval, the range is divided by the number of classes desired. Class interval is usually denoted by the symbol ' i ' and is always a whole number. Thus the formula for deciding the class interval is—

$$i = \frac{\text{Range}}{\text{Number of Classes Desired}}$$

Now the question arises in how much classes or groups one should distribute given data. As a general rule Tate writes, "If the series contains fewer than about 50 items, more than about 10 classes are not justified. If the series contains from about 50 to 100 items, 10 to 15 classes tend to be appropriate. If more than 100 items, 15 or more classes tend to be appropriate. Ordinarily, not fewer than 10 classes or more than 20 are used" (1955, p. 44).

If by dividing Range by number of classes we do not get a whole number, the nearest, appropriate number is taken as class interval.

Second Rule. According to the second rule class interval (i) is first decided and then the number of the classes is determined. For this purpose, usually, the class intervals of 2, 3, 5 or 10 units in length are used.

Both of the above mentioned rules are practised. In our opinion, it is better to use a combined procedure made out of both the rules. Actually the range, the number of classes and the class interval—all should be taken into consideration while planning for a frequency distribution and we must aim to select a proper class interval (i) that can yield, appropriate categories (number of classes) as mentioned above by Tate.

Considering in this way, the proper class interval (i) in the present example is 5.

[Here Range = 47. Scores are 50 in number and thus about 10 classes are sufficient. Therefore $i = 47/10 = 4.7$ i.e. Nearest whole number = 5].

3. Writing the Content of Frequency Distribution. After deciding the size and number of the class interval and locating the highest and lowest scores of the given data, we proceed to write down the contents of the frequency distribution. For this purpose 3 columns are drawn and work is carried out as under:

(a) **Writing the classes of distribution.** In the first column we write down all the classes of distribution. For this purpose first of all the lowest class is settled down and afterwards other subsequent classes are written down. In the present problem 20—24 can be taken as the lowest class and then we can have classes as 25—29, 30—34, etc. upto 65—69.

(b) **Tallying the Scores into proper classes.** Under this step, the scores given in the data are taken one by one and tallied in their proper classes as shown in the 2nd column of the table given below. These tally marks against each class are then counted. These counted numbers are respectively called the frequencies of that class. They are written in the third column as shown below:—

Table 13.2

Class of Scores	Tallies	Frequencies
65—69		1
60—64		3
55—59		4
50—54		7
45—49		9
40—44		11
35—39		8
30—34		4
25—29		2
20—24		1
Total Frequencies (N)		50

(c) **Checking the tallies.** The total of 3rd column should be equal to the number of individuals whose scores have been tabulated. Under the above tabulation total of frequencies i.e. 50 agrees with the total number of students given in the problem.

Some more things to be known regarding a frequency distribution.

1. **Class limits of the frequency distribution.** The designation of classes i.e. 20—24, 25—29, 30—34 etc. are called the indicated or written class

limits. The actual class limits are always taken as 0.5 units below and 0.5 units above the written class limits. For example the actual limit of class 20—24 is 19.5—24.5 (19.5 as lower and 24.5 as higher class limits.)

2. *The Mid-point of a class in a frequency distribution.* In a frequency distribution classes are sometimes indicated by their mid-values or mid-points. The formula of determining the mid-point of a class is—

$$\text{Mid-point of a class} = \text{Indicated or written lower limit} + \frac{(\text{upper limit} - \text{lower limit})}{2}$$

[Note. We don't consider actual class limits in calculating mid-point. Thus. of the class 20—24 the mid-point is $20 + \frac{24-20}{2} = 20 + 2 = 22$.

C. The Graphical Representation of Ungrouped Data

For the data which is not grouped into a frequency distribution we use the following common graphs or diagrams.

- (i) Pictographs or Pictograms. (ii) Bar graphs or Bar Diagrams.
(iii) Circle or pie graphs/diagrams (iv) Line graphs.

Let us have an idea of all these four types of graphical representation

Pictographs or pictograms

Pictographs or pictograms are the graphs or diagrams used for presenting an ungrouped statistical data in a pictorial (picture like) form. A picture is said to be worth more than 100 words spoken or written. Thereby the pictorial representation of the data is always considered better than its description in the words and figures. Let us illustrate this fact through an example.

Example 13.1. In a physical efficiency test 100 students cleared from District A, 85 students from district B, 80 students from district C, 90 students from district D and 70 students from district E. Presentation data first into a tabulation form and then in pictorial form.

Solution. Presentation of data in a Tabular Form Table 13.3.

District	A	B	C	D	E
Number of Students	100	85	80	90	70

Presentation of Data in the pictorial form

Step 1. Let us decide to represent a student with a picture (indicative of a student figure)

Step 2. For the sake of brevity and simplicity let us have a scale, a picture (of student) equal to 20 students in number.

Following these steps the pictorial presentation (pictograph) of the given data will be as under—

How to draw bar graph ?

- Try to use a graph paper for drawing the bar graph.
- On one of the axes X or Y try to plot numerical data by choosing a proper scale and have the other variable like classes in this example of students has been plotted on the y-axis. Here the numerical strength of students in the different classes are thus represented by the bars (rectangles of similar breadth) constructed on the x-axis.

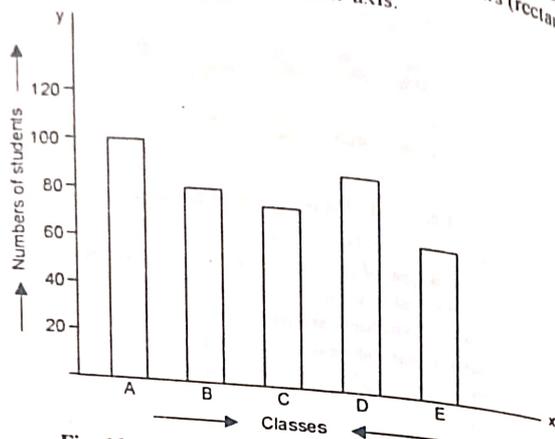


Fig. 13.2. Bar graph or Bar diagram showing the strength of students passed the efficiency test.

What can be inferred from the Bar graph ?

A bar graph just shown above in the figure 13.2 may provide the following information in a quite simple and speedy way.

- It shows the strength of students cleared the test belonging to a particular district i.e. 70 students cleared the test from district E.
- The district having highest strength of the students cleared the test in district A.
- The district having lowest strength of the students cleared the test in district E.
- The relative strengths of the students clearing the test from different districts of the state may also be adjudged easily for one or the other type of comparisons.

Organization and Graphical Presentation of Data

Circle graph or Pie diagrams

Circle or pie graphs/diagrams provide us an opportunity to represent statistical data through the figure of a circle and its constituents i.e. proportionate sub-divisions. These are specifically helpful in the case for which the question of proportion is of much interest. To construct them requires a working knowledge of angle measurement and percentages.

The process of the construction of a pie graph may be understood with the help of an example given below.

Example 13.2— 200 students of a Students' hobby club were asked to give their options for the participation in one or the other types of co-curricular activities. The preferences data was tabulated as under

Activities	Debate	Dance	Music	Painting	Models	Excursion
Number of Students	42	36	36	12	6	68

Present this data through a pie diagram or Circle graph.

Solution— The steps for the construction of the required pie diagram may be outlined as below—

- A circle has the value of 2π (2 pic) i.e. 360° . In the present example the total sample is 200 which has to be represented through a complete circle having 360° .
- The various constituents of the collected data i.e. preferences for the one or the other co-curricular activities then may be assigned by varying values of pic in terms of the degrees as computed below—

Debate : Number of students = 42 out of 200
Proportion out of 200 = 21%

$$\text{Proportion out of } 360^\circ = \frac{42}{200} \times 360^\circ = 75.6^\circ$$

Dances & Music : No. of Students = 36 out of 200

$$\text{Proportion out of } 200 = \frac{36}{200} \times 100 = 18\%$$

$$\text{Proportion out of } 360^\circ = \frac{36}{200} \times 360^\circ = 64.8^\circ$$

Painting : No. of Students = 12 out of 200

Proportion out of $360^\circ = 12 \times 360^\circ = 21.6^\circ$
Modelling : No. of Students 6 out of 200

Proportion out of 200 = $\frac{6}{200} \times 100 = 3\%$

Proportion out of $360^\circ = \frac{6}{200} \times 360^\circ = 10.8^\circ$

Excursion : No. of Students = 68 out of 200

Proportion out of 200 = $\frac{68}{200} \times 100 = 34\%$

Proportion out of $360^\circ = \frac{68}{200} \times 360^\circ = 122.4^\circ$

- (iii) Now all these above proportions $75.6^\circ, 64.8^\circ, 64.8^\circ, 21.6^\circ, 10.8^\circ$ and 122.4° may be represented as the different sectors of a whole circle with the help of the knowledge concerning measurement of angles.
- (iv) These may take the final following form for making the required pie diagram.

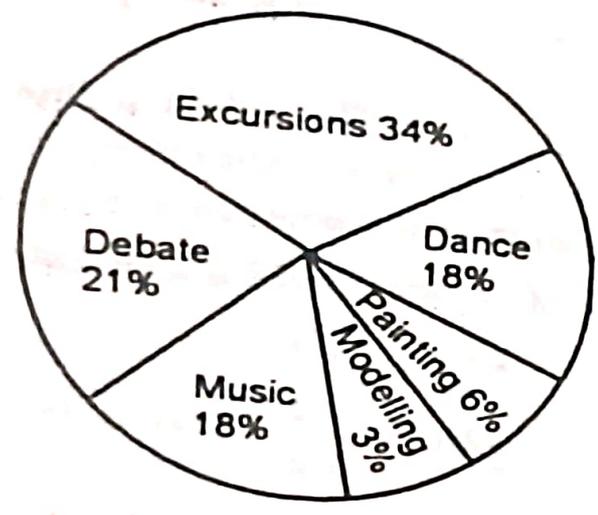


Fig. 13.3. Pie graph showing preferences of students showing their preferences for the co-curricular activities

Line graphs

Line graphs can be better used in describing the con-committed relationships between two variables by plotting their respective values on the x and y axes of a graph paper (After choosing appropriate scales). Let us illustrate this fact through examples.

2. What was the high temperature of the day according to the graph?
3. Between what hours was the temperature increasing or decreasing?
4. About what time in the morning was the temperature about 10° ?
5. What do you predict the temperature might be at 5.00 p.m. lower than or higher than 16°C ?

Example 13.4. The line graph given below in Fig. 13.5 depicts mastery of multiplication facts by a particular student in the a course of learning. Here the time spent in weeks for having mastery over the multiplication facts is shown on x-axis and the achievement in terms of mastery (known through the percentage of facts mastered) is shown on y-axis by choosing appropriate scales.

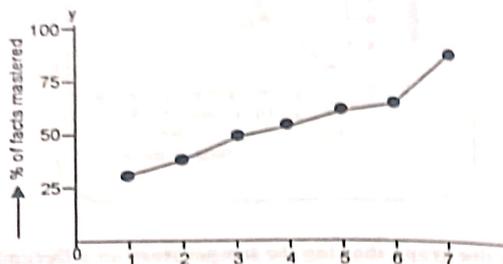


Fig. 13.5. Line graph showing progress about mastery over the multiplication facts

Conclusion about choosing a particular graphical mode for the representation of ungrouped data.

Each of the graphical mode, pictograph, pie graph and line graph, described above have their own merits and limitations of being utilised in the representation of a given ungrouped data at a particular occasion to furnish useful information. Therefore, a wise decision should always be made before the employment of a particular graphic mode in a particular situation. Take the last example of representing the data concerning mastery over the multiplication by a line graph. Here it would make no sense whatever to turn these weekly mastery figures into a pie or bar chart. There is also no possibility of representing these through pictograph. Similarly in the case of representing facts concerning the percentage of pets, there will be no sense in displaying them through a line graph. Here the decision for representing them through a pie graph seems quite appropriate as there stands

a whole of which the different figures concerning pets choices are collectively a part. Contrarily in the case, showing concomitant changes occurred in one variable, relation to the changes introduced in the other, it is always advisable to use line graph as the mode of representation. In this way, while trying to determine how to best display the particular data, one must decide whether to graph the data, and if so, what kind of graph to use.

B. Graphical presentation of Frequency distribution (Grouped data)
There are four methods of representing a frequency distribution graphically.

1. The Histogram or column diagram
2. The Frequency Polygon
3. The Cumulative Frequency Graph
4. The Cumulative Frequency Percentage Curve or Ogive

Let us discuss them one by one.

The Histogram. A histogram or column diagram is essentially a bar graph of a frequency distribution. The following points are to be kept in mind while constructing the histogram for a frequency distribution —

(i) The scores in the form of actual class limits as 19.5—24.5, 24.5—29.5 etc. are taken in the construction of a histogram

(ii) It is customary to take two extra intervals (classes) one below and other above the given grouped intervals or classes (with zero frequency). In the case of frequency distribution given in table 13.2, we can take 14.5—19.5 and 69.5—74.5 as the two required extra-intervals

(iii) Now we take the actual lower limits of all the class-intervals (including the extra intervals) and try to plot them on x-axis. The lower limit of the lowest intervals (one of the extra intervals is taken at the intersecting point of x-axis and y-axis)

(iv) Frequencies of the distribution are plotted on y-axis

(v) Each class or interval with its specific frequency is represented by a separate rectangle. The base of each rectangle is the width of the interval (i) and the height is the respective frequency of that class or interval

(vi) It is not essential to project the sides of the rectangles down to the base line

(vii) Care should be taken to select the appropriate units of representation along the x-axis and y-axis. Both x-axis as well as y-axis should not be either too short or too long. "A good general rule for this purpose as suggested by Garrett" is to select x and y units which will make the height of figures approximately 75% of its width" (1971, p. 11)

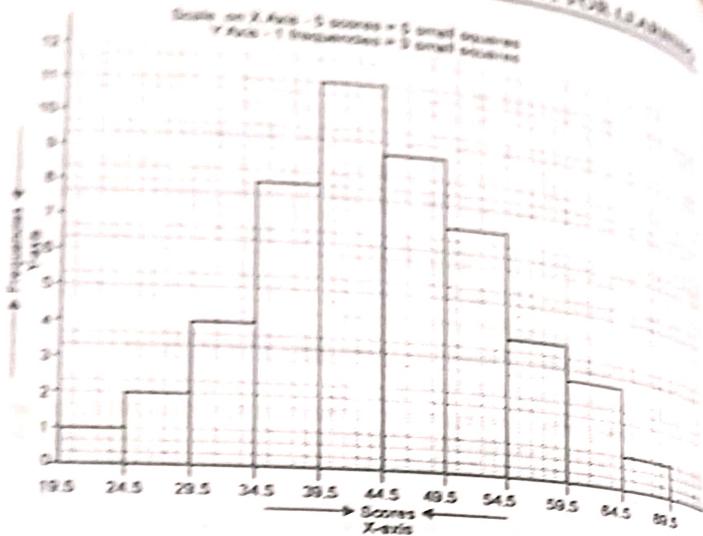


Fig. 13.6. Histogram of the Frequency Distribution given in Table 13.2.

The Frequency Polygon. A Frequency polygon is essentially a line graph for the graphical representation of the frequency distribution. We can get a frequency polygon from a histogram, if the mid-points of the upper bases of the rectangles are connected. But it is not essential to plot histogram first to draw a frequency polygon. We can construct it directly from a given frequency distribution. The following points are helpful in constructing a frequency polygon :—

- (i) Like histogram two extra intervals or classes one above and the other below the given intervals are taken.
- (ii) The mid-points of the all classes or intervals (including two extra intervals) are calculated.
- (iii) The mid-points are marked along the x-axis and the corresponding frequencies are plotted along the y-axis by choosing suitable scales on both axes.
- (iv) The various points obtained by plotting the mid-points and frequencies are joined by straight line to give the frequency polygon.

(iv) For the approximate height of the figure and selection of x and y units the rule emphasized earlier in the case of histogram should be followed.

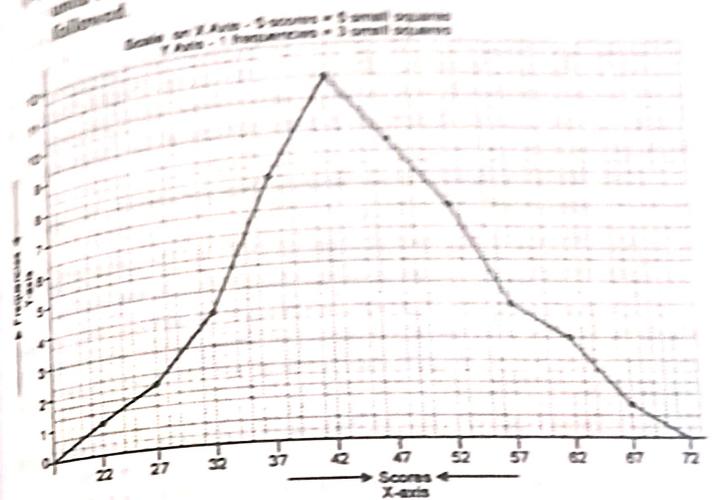


Fig. 13.7. Frequency Polygon of the Frequency Distribution given in Table 13.2

Difference between A Frequency Polygon and A Frequency Curve

A polygon is a many sided figure. It is essentially a closed curve while frequency curve is not a closed curve. In Frequency curve we do not take two extra classes or intervals, one above and the other below the given classes. But in Frequency polygon, we take these two extra classes in order to close the figure.

Comparison between the Histogram and the Frequency Polygon

Although Histogram and Frequency polygon-both are used for the graphic representation of the frequency distribution and are alike in many aspects yet they possess points of differences. Some of these differences can be cited as below :

1. Where Histogram is essentially the bar graph of the given frequency distribution, the Frequency polygon is a line graph of this distribution.

2. In Frequency polygon we assume frequencies to be concentrated at the mid-points of the class interval. It points out merely the graphical relationship between mid-points and frequencies and thus is unable to show the distribution of frequencies within each class interval. But the Histogram gives a very clear as well as accurate picture of the relative proportions of frequency from interval to interval. A mere glimpse of the figure answers such questions as :—

- Which group of class-interval has the largest or smallest frequency?
- Which pair of groups or class intervals has the same frequency?
- Which group has its frequency double that of another?

3. In comparing two or more distributions by plotting two or more graphs on the same axes, Frequency polygon is more useful and practicable than the Histogram as in such cases vertical and horizontal lines in the histogram tend to coincide.

4. In comparison to Histogram, Frequency polygon gives a much better conception of the contour of the distribution. With a part of the polygon curve, it is easy to know the trend of the distribution but a Histogram is unable to tell such a thing.

The Cumulative Frequency Curve or Graph

A cumulative frequency curve or graph is essentially a line graph drawn on graph paper by plotting actual upper limits of the class intervals on the X-axis and the respective cumulative frequencies of these class intervals on the Y-axis. Let us consider the data given in the frequency distribution in Table 13.1 to explain the process of construction of a cumulative frequency graph. Main points may be summarized in the following manner :

- First of all, we will calculate the actual upper limits of the class intervals as 24.5, 29.5, 34.5, 39.5, 44.5, 49.5, 54.5, 59.5, 64.5, 69.5 and 74.5.
- Then we will try to determine/compute cumulative frequencies and write them at the proper place against the respective class interval in the manner given ahead in the table 13.4.

Table 13.4. Computation of Cumulative Frequencies

Class Interval	Frequency	Cumulative Frequency
	1	50
	3	49
65 — 69	4	46
60 — 64	7	42
55 — 59	9	35
50 — 54	11	26
45 — 49	8	15
40 — 44	4	7
35 — 39	2	3
30 — 34	1	1
25 — 29		
20 — 24		

As may be clear to you with the observation of the cumulative frequencies written in the third Column the table 23.2, cumulative frequencies are then obtained by adding successively starting from the bottom, the individual frequencies. In the given table, when we start from the bottom the first cumulative frequency is to be written as 1 against the lowest class interval, *i.e.* 20-24. Then we get 3 as another cumulative frequency by adding 1 and 2, then 7 by adding 1, 2 and 4. Similarly, by adding 1, 2, 4 and 8, we get 15 as a cumulative frequency to be written against the interval 35-39. As the actual upper limit of this class interval is 39.5, it may be safely claimed that there are 15 students in the class of 50 students whose achievement scores lie below 39.5.

- Now, for plotting the actual upper limits of the class intervals on the X-axis and respective cumulative frequencies on the Y-axis of the graph paper, we must select a suitable scale with reference to the range of data to be plotted and the size of graph paper to be used.
- All the plotted points representing upper limits of the class interval with their respective cumulative frequencies will then be joined through a successive chain of straight lines resulting in a line graph.
- To plot the origin of the curve on the X-axis, it is customary to take one extra class interval with zero cumulative frequency and thus calculate the actual upper limit of this class interval. In the present case the upper limit will be 19.5. It will be the starting point of the curve.
- Cumulative frequency curve of the frequency distribution given in table 13.2, then will look like below as given in the figure 13.8.

frequencies tell us the percentage of cases lying below a given score or class limit. For example, the cumulative frequency of 15 can be converted into cumulative percentage frequency by multiplying by $100/N$, i.e. $100/50 = 2$. Thus, we obtain 30 as the cumulative percentage frequency against the class interval 35-39. This cumulative percentage frequency may help us conclude that there are 30% of students in the class of fifty, whose achievement scores lie below the score 39.5. Similarly, the cumulative percentage frequency of 70 may tell us that there are 70% of students whose scores lie below the upper limit of the class interval 45-49, i.e. 49.5.

(ii) After computing the cumulative percentage frequencies in the manner given above these may be arranged in the way given in table 13.5.

Table 13.5. Computation of Cumulative Percentage Frequencies

Class interval	Frequency	Cumulative frequency	Cumulative percentage frequency
65 — 69	1	50	100.00
60 — 64	3	49	98.00
55 — 59	4	46	92.00
50 — 54	7	42	84.00
45 — 49	9	35	70.00
40 — 44	11	26	52.00
35 — 39	8	15	30.00
30 — 34	4	7	14.00
25 — 29	2	3	6.00
20 — 24	1	1	2.00

- (iv) Now the actual upper limits of the class intervals are plotted on the X-axis and respective cumulative percentage frequencies are to be plotted on the Y-axis by selecting a suitable scale with reference to the range of data to be plotted and the size of the graph paper to be used.
- (v) To plot the origin of the cumulative percentage frequency or ogive on the X-axis, it is customary to take one extra class interval with zero cumulative percentage frequency and then calculate the actual upper limit of this extra class interval. In the present case also this upper limit (like already discussed for the cumulative frequency curve) will be 19.5. It will be starting point of the curve.

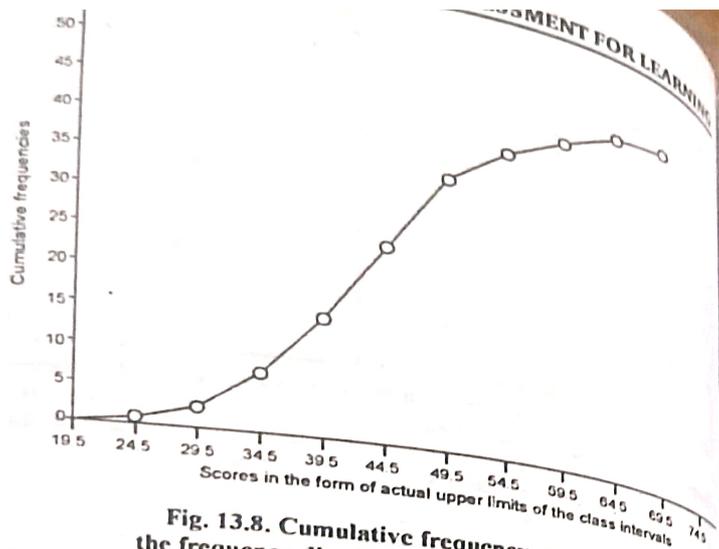


Fig. 13.8. Cumulative frequency curve of the frequency distribution given in Table 13.2.

The Cumulative Percentage Frequency Curve or Ogive

The cumulative percentage frequency curve or ogive is essentially a line graph drawn on a piece of graph paper by plotting actual upper limits of the class intervals on the X-axis and their respective cumulative percentage frequencies on the Y-axis. Ogive differs from the cumulative frequency graph in the sense that here we plot cumulative percentage frequencies on the Y-axis in place of cumulative frequencies. The question here may arise that how can we compute cumulative percentage frequencies.

Four computing cumulative percentage frequencies of scores grouped into a frequency distribution the steps like below are followed :

- (i) First we compute cumulative frequencies as discussed earlier and presented in the table 13.3.
- (ii) Then these cumulative frequencies are converted into cumulative percentage frequencies.

For converting cumulative frequencies into cumulative percentage frequencies, the particular cumulative frequency is multiplied by $100/N$, where N is the total number of frequencies (total number of students whose achievement scores have been included in the present example). These

...representing upper limits of the class intervals joined through a successive chain of straight lines resulting into a line graph looked like as ahead (see figure 13.9).

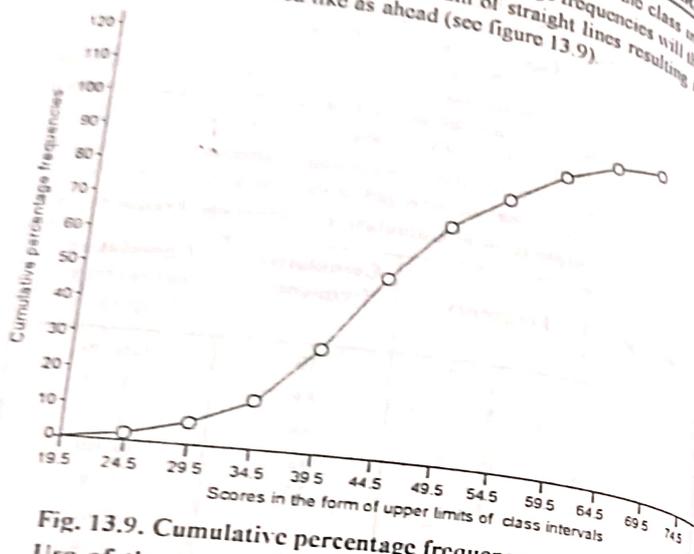


Fig. 13.9. Cumulative percentage frequency curve or ogive.

Use of the cumulative percentage frequency curve or ogive. Cumulative percentage frequency curve (ogive) helps in the following tasks:

1. The statistics like median, quartiles, quartile deviations, deciles, percentiles and percentile ranks may be determined quickly and fairly accurately.
2. Percentile norms (a type of norm representing the typical performance of some designated group or groups) may be easily and accurately determined.
3. We can have an overall comparison of two or more groups or frequency distributions by plotting the ogives concerning these distributions on the same coordinate axes. A frequency curve may also be used for such comparison. The difference lies in the fact that a frequency curve is used in the case when the total frequencies (N) in the distributions are the same, but when the total frequencies are different, we have to draw the frequency percentage curve or ogive.

A. ESSAY TYPE QUESTIONS

1. Discuss in brief the different methods of organising and presenting statistical data.
2. What is Frequency distribution? How can you present a data in the form of a frequency distribution? Illustrate your answers with an example.
3. Tabulate the following 25 scores into a frequency distribution using an appropriate interval.
72, 75, 77, 67, 72, 81, 68, 65, 86, 73, 67, 82, 76, 70, 76, 70, 83, 71, 63, 72, 72, 61, 67, 84, 69, 64.
4. What is a Histogram? How does it differ from a Frequency polygon?
5. Plot Histograms and frequency polygons separately on the different axes for the following distributions:

(a) Scores	f	(b) Scores	f	(c) Scores	f
75-79	1	60-69	1	37-39	2
70-74	3	70-79	2	34-38	4
65-69	5	80-89	3	31-33	6
60-64	8	90-99	4	28-30	10
55-59	11	100-109	7	25-27	12
50-54	18	110-119	12	22-24	7
45-49	10	120-129	8	19-21	7
40-44	8	130-139	5	16-18	3
35-39	6	140-149	3	13-15	2
30-34	3	150-159	3	10-12	1
25-29	1				
20-24	1				
	N = 75		N = 50		N = 54

6. Name the different graphs or diagrams used for the graphical presentation of ungrouped data. Discuss any one of them by taking a hypothetical data.

7. What are pictographs or pictograms? Illustrate the procedure of drawing a pictograph with the help of an example.
8. What is a bar graph or bar diagram? Illustrate the procedure of representing ungrouped data through a bar diagram with the help of some hypothetical data.
9. What is a circle or pie diagram? Illustrate the procedure of representing ungrouped data through a pie diagram with the help of some hypothetical data.
10. Make a pictograph of the following tabular data.

Name of Work Experience	Gardening	Book Binding	Cooking	Clay Modelling	Art and Painting
No. of students opted	60	30	40	45	25

11. The data shown in the given table presents the figure of the merit positions earned in the X and XII classes by a school in different years. Draw a bar graph for representing this data.
12. Draw a line graph for the data presented in the problem 11.
13. Draw a pie diagram for representing the data presented in the problem 10.
14. What is a line graph? How can it be used for representing an ungrouped data? Illustrate the process by taking some hypothetical data.
15. Name the various methods used for presenting a frequency distribution (grouped data) in a graphical form. Discuss any one of them in detail.
16. What is a histogram? Illustrate the procedure of drawing histogram for the presentation of a given frequency. Distribution with the help of an example.
17. What is a frequency polygon? Discuss the procedure of its construction with the help of an example.
18. What is a Cumulative frequency curve? How it can be drawn? Illustrate by taking a hypothetical frequency distribution data.

Year	1997-98	1998-99	1999-2000	2000-01	2001-02
No. of Merit positions	4	1	24	13	16

SHORT ANSWER TYPE QUESTIONS

1. What is data? Name the various methods used for the organisation and presentation of data.
2. How can the data be presented through a statistical table? Illustrate with the help of a hypothetical example.
3. What is a frequency distribution?
4. What do you mean by class interval of a frequency distribution? How is it computed? Illustrate with example.
5. How is a pie graph? Explain with the help of hypothetical diagram.
6. What is a bar graph? Explain with the help of hypothetical diagram.
7. What is a histogram?
8. What is a frequency polygon?
9. Distinguish between the histogram and frequency polygon.
10. What is a cumulative frequency curve?

Scales of Measurement

CHAPTER OUTLINE

- Concept of Measurement Scales
- Different Scales of Measurement
 - Nominal scale
 - Ordinal scale
 - Interval scale
 - Ratio scale
- A summarized Description of the four scales
- Study Questions

Concept of Measurement Scales

Measurement of the behaviour, object or an event in operation may be defined as an attempt to quantify, i.e. assigning numerals/numbers to it according to some specified rules. The differences in the prescription of these rules in fact give birth to different kinds of measurement scales known generally as nominal, ordinal, interval and ratio scales (Figure 14.1)

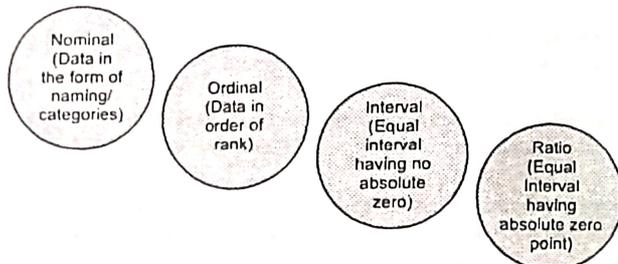


Figure 14.1 Scales or levels used in measuring or collecting data.

These measurement scales, according to Goodwin (2008:129), represent four different ways of assigning numbers to events or behavioural responses of our subjects of the study.

In collecting information or evidences from the available sources, the researchers in behavioural sciences may be observed to make use of these four scales or levels of measurement depending upon the type of data needed, instrument used and the situations allowing them to collect data.

These four scales or levels at which researchers measure and collect their data may found to reflect a unique hierarchy in their level of functioning. The lowest level is nominal and the highest is ratio. The letters—NOIR (No Oil IN Rivers)—are the first letters of the scales in order from lowest to highest (Patten, 2007:107).

Let us know more about these four levels or scales of measurement.

Nominal Scales

The measurement of behaviour, objects or events in nominal scales, is characterized by features as given below.

1. It represents the lowest level in the hierarchy of the four levels or scales measurement. The measurement obtained through the use of nominal scale, therefore, is considered the weakest in comparison to the measurements carried out at other three levels named as ordinal, interval and ratio.
2. The only purpose for carrying out measurement by the researchers at such low level is to classify/categorize/identify objects, individuals or events related to their data collection task.
3. It is a simple method of classification, categorization or labelling rather than an arrangement on a continuum scale.
4. It is carried out purely at the "naming" level. In other words, the researcher obtains nominal data by classifying the measured phenomenon according to names (words) instead of quantities or numbers. For instance, when researchers ask the participants to name their marital status, participants will respond with words, not numbers, such as "married", "single", "divorced" and so on.
5. If the researcher happens to assign the numbers 1, 2, 3, 4, etc. (as may be seen in Example 3 given ahead) to classify the measured phenomena or events, it serves only to classify them into one group or another. The label numbers do not stand for quantities. Hence nominal data do not provide quantitative information. One cannot use these numbers in computing any statistics like mean, median, SD or correlation etc.
6. At this level of measurement, the measuring process is simply partitioning a group into mutually exclusive sub-classes. The only relationship involved is that of equality, that is, the members of a

sub-group are equal (equivalent) in the property scaled or measured (Taylor, et al., 2006:128).

- 7. Studies using these scales typically assign people to categories according to their individual characteristics and count the number of people falling into each category (as their frequencies), e.g.

Marital Status	Married	Unmarried	Divorced	Widow/ Widower
Frequency	240	120	80	60

- 8. Nominal data do not put participants in any particular mathematical order. There is no logical basis for saying that one category, such as "married", is higher or lower mathematically than any other category like "unmarried", "divorced" or "widowed" etc.

- 9. A unique feature of nominal data lies in its passing just one test: "Different numbers must mean different things." For example, a 1 might be assigned to the female gender and a 2 to the male gender. However, values assigned for naming the categories remain fixed. Once a number has been assigned to a given category, all other items with the same characteristics must receive the same number or label (McNabb,2008:116).

Examples of nominal data collected by using nominal scale

- 1. Classification of (i) people as married, unmarried, divorced, widowed etc, (ii) Gender as male and female (iii) classification of schools as government, aided, self-financed, rural, urban etc., and (iv) attitudes as positive-negative or favourable-unfavourable etc.

- 2. We use nominal scales in the situations like:

- (i) Comparing male and female joggers, who are more likely to run during the morning and who are more likely to run in the evening.

Data collected from the 60 participants (30 males and 30 female joggers) may be tabulated below:

	Male joggers	Female joggers
Morning	20	16
Evening	10	14

- (ii) Assigning the values of 0 and 1 to groups of users versus non-users of a service or practice such as remedial instruction.
- (iii) Arbitrarily assigning the values of 1 and 2 to the categories of some kinds like smokers and non-smokers or registered voters and non-registered voters etc.

- 3. Nominal data is also generated when we ask questions in the manner like below.

Question	Options for providing response	Code to provide response
What profession would you like to adopt? (circle the code)	Doctor Engineer Teacher Other than the above	1 or A 2 or B 3 or C 4 or D

Ordinary Scales

The measurement carried out at the ordinal level represents the level higher than nominal but lower than the interval and ratio scales in the hierarchy of measurement scales. Ordinal scales provide the researchers an opportunity to rank the persons, objects, events or phenomena in relation to their characteristics under observation. As a result, in measuring the behaviour, objects or events at the ordinal level, the researchers try to place participants in order from high to low. Traditionally, for doing so, researchers give a rank of 1 to the participants highest in attainment of some characteristics, 2 to the next highest, and so on. In brief, the measurement carried through ordinal scales are mainly characterized as given below:

- 1. These scales are used by the researchers in the situations when they have several categories comprising a particular variable and where (i) in addition to the property of equivalence, the categories can be assigned a meaningful order, and (ii) greater than and less than relationships can be identified (Taylor et al., 2006:128).

For example, the measurement outcomes in the form of income subcategories like above average, average, below average provide a proper ordinal ranking. Here, we have several categories that can be provided a meaningful order allowing us to establish greater or less than relationship between them.

- 2. An ordinal scale supplies more information than a nominal scale, so more than one rule applies. The data must not only pass the nominal scale rule, i.e. different numbers mean different things but also must pass the second test, i.e. things being measured can be ranked or ordered along some dimension" (McNabb, 2008:116).
- 3. From such rankings, the researchers can infer that one participant is higher or lower in his performance than another.

4. Here relative position is the only thing we know. Studies using ordinal scales are found to have the research questions like below in focus.
- If a child ranks five toys and assigns the rank third to a particular toy out of these five. Will the ranking for that toy go down after the child has played with it for a week?
 - Do students rank textbook authors in the sciences and in the humanities differently when they are told the gender of the authors?
 - How do young versus old people rank 10 movies that vary in the levels of sex and aggression found in them?
5. It is important to note that ranks do not indicate the amount by which participants differ and thus the measurement carried out at ordinal level does not reflect the property of equal interval between the well classified and ranked categories. Let us illustrate it through a working example,

A researcher wants to classify the participants of his research study by the level of their socio-economic status such as higher, upper middle, middle, lower middle, and low and for this purpose, asks a question in the format provided below.

Question	Options for providing response	Code to provide response
What is the annual income of your family?	More than 10 lac	5 or A
	Between 5 and 10 lac	4 or B
	Between 2 and 5 lac	3 or C
	Between 1 and 2 lac	2 or D
	Less than 1 lac	1 or E

Here, although one is using an order of five categories for representing the differences between the annual income of the families in his survey study for knowing about their socio-economic status, yet from this classification he is not suggesting that the differences between five categories are the same. In other words, he does not mean that $5 - 4 = 4 - 3$, $4 - 3 = 3 - 2$, $3 - 2 = 2 - 1$. More specifically, it can be said that the numbers are used only to provide options for identifying the categories of nominal scale (one can also use letters A, B, C, D, place of numbers 1, 2, 3, 4 and 5 for this purpose). These numbers cannot be made the subject of mathematical operations such as doing addition, subtraction, multiplication, division or computing statistics like mean, median, and SD much in the same way as done in the case of the data obtained from interval or ratio scales.

Interval Scales

In the hierarchy of measurement scales, interval scales lie one step ahead of the ordinal scales but remain one step behind the most sophisticated measurement scale known as ratio scales. As a result, the interval scales are not only endowed with all the characteristics and features of nominal and ordinal scales but go a step further to include the concept of equal intervals between the events that are ordered. As a definition, the interval scales are those scales of measurement on which equal intervals between objects/events represent equal differences.

In the opinion of McNabb (2008:117), to qualify as an interval scale, a measurement must pass three tests. First, the different numbers must mean the different things. Second, the things measured can be ranked or ordered on some appropriate dimension. Third, the most important rule, is that the differences between adjacent levels on the scale are (or are assumed to be) equal.

The researches using psychological tests of personality, attitude, achievement, ability and adjustment are the most common examples of studies typically considered to make use of interval scales. Someone with an IQ of 120 is believed to be more intelligent than someone else with an IQ of 110. Furthermore—and this is the defining feature of an interval scale—the difference in intelligence between people with IQs of 120 and 110 is assumed to be the same as the difference between people with IQs 110 and 100. (Goodwin, 2008:130). It also applies to the measures of other properly standardized and calibrated psychological, academic and performance tests. The intervals between the scores earned on a standardized achievement test (using objective type questions) are also fairly uniform. We can say the difference between the scores 70 and 80 is same as between the scores 50 and 60 or 20 and 30.

The quantification of the observed and measured characteristics of the subjects or events of the study can be satisfactorily carried out in behavioural sciences researches with the help of the measures taken on interval scales. Moreover, the measures available on the interval scales are subjected to mathematical and statistical operations. Consequently one can add, subtract, multiply, divide and compute, mean, SD, correlation and other statistics and have as many number of mathematical and statistical operations as needed by him in collecting or analysis of his research study data.

However, the interval scales fall short of the ratio scales in the sense that they do not possess absolute zero like the ratio scales. With interval scales, a score of zero is simply another point on the scale — it does not mean an absence of the quantity being measured. The most suitable example

of the interval scales measurement involving no absolute zero may be provided with the measure of temperature. In such measures zero degrees Celsius or Fahrenheit does not mean an absence of heat, it is simply a point on the scale that reminds you an extreme condition of bitter cold. Likewise, if a test of emotional intelligence has scores ranging from 0 to 20, a score of 0 is simply the lowest point on the scale and does not mean the complete absence of emotional intelligence. Similarly, a zero earned by a student on a multiple choice test does not mean that he has no knowledge or skills in that subject area. He may be thought to have some knowledge of simple facts, definitions, and concepts, but the test was designed to measure at the low skill level at which the student is operating. Thus, a score of zero here in this test simply indicates that the student knows nothing on that test, not that the student has zero knowledge of the content of the subject tested.

Ratio Scales

In the hierarchy of measurement scales, the ratio scales lie on the top of this hierarchy. The measures taken on this scale not only incorporate all the good features and characteristics of the nominal, ordinal and interval scales measurement but also additionally endowed with a special feature of possessing an absolute or true zero point. That is, for ratio scores, a score of zero means the complete absence of the attribute being measured. For instance, an error score of zero, attained by a rat running a maze, means the absence of any wrong turns. Ratio scales are necessarily used in the studies of natural sciences where one needs to make use of the concept of true zero for having the measures in their right proportions, multiples and fractions. A measure taken on a ratio scale can be expressed in terms of multiples, division, percentages and fractions of any other measures taken on the same scale. That is why we can safely and accurately say that 5 kg is five times of 1 kg, a 10 km distance is half of the 20 km distance travelled in a journey, 15 minutes time spent in reading is three times of the 5 minutes time needed for writing, and a two rupee currency is double the one rupee currency etc.

In behavioural sciences, the use of ratio scales is very much limited to the studies where one has to resort to physical measures such as height, weight, distance, time, age, income and currencies etc. in his data collection task. However, it is worth noting that it is only with the ratio scales that we can calculate the ratio of a pair of measures. For example, the statements like this item/person has twice the amount of what has been measured for the other item/person, can only be made if the property in question is measured in a ratio scale (Taylor et al. 2006:131–32).

A summarized description of the four scales

The measurement scales, may be found to have their unique features and characteristics for helping the researchers in behavioural sciences to collect data with the observation and measurement of the attributes of the things, persons or events related to their study. How these four scales differ from each other in terms of their unique features and applications may be understood through a summarized description provided in Table 14.1.

Table 14.1 Characteristics and examples of the four measurement scales

Measurement scale	Examples	Characteristics of the scale
Nominal	<ul style="list-style-type: none"> A. Tree, house, taxi etc B. Gender: male/female C. Attitude: favourable/unfavourable D. Political parties: <ul style="list-style-type: none"> – Labour – Liberal – Democrat E. Psychiatric disorders: <ul style="list-style-type: none"> – Schizophrenic – Paranoid – Manic-depressive etc. F. Religions: <ul style="list-style-type: none"> – Christian, – Islam, – Hindu etc. G. Types of school: <ul style="list-style-type: none"> – Government school – Aided school – Private school 	<ul style="list-style-type: none"> • Each subgroup has a characteristic/property which is common to all classified within that subgroup • Measures without order simply indicates that two or more classifications are different • Nominal data, being the least powerful need to pass only a simple test: <i>Different numbers must mean different things</i>
Ordinal or ranking	<ul style="list-style-type: none"> • Income <ul style="list-style-type: none"> – Above average – Average – Below average • Socioeconomic status: <ul style="list-style-type: none"> – Upper, – Middle, – Low 	<ul style="list-style-type: none"> • It has the characteristics of a nominal scale, e.g. individuals groups characteristics classified under a subgroup have a common characteristic Plus Subgroups have a relationship to one another. They are arranged in ascending or descending order

	<ul style="list-style-type: none"> • Attitudes. <ul style="list-style-type: none"> - Strongly favourable - Favourable - Uncertain - Unfavourable - Strongly unfavourable • Attitudinal scale (Likert scale-these are numerical categories): <ul style="list-style-type: none"> - 0-30 - 31-40 - 41-50 etc. • The letter grading system 	<ul style="list-style-type: none"> • Measures with order, indicates that the measurement classifications are different and can be ranked • Ordinal scale supplies more information than a nominal scale. Hence more than one rule applies to it. It should pass two tests <ul style="list-style-type: none"> (i) <i>Different numbers mean different things</i> and (ii) <i>Things being measured can be ranked or ordered along some dimension.</i>
Interval (or equal unit)	Temperature <ul style="list-style-type: none"> - degree Centigrade - degree Fahrenheit Performance on a standardized achievement test <ul style="list-style-type: none"> Attitudinal scale (Thurstone scale): <ul style="list-style-type: none"> - 10-20 - 21-30 - 31-40 - 41-50, etc. 	<ul style="list-style-type: none"> • It has all the characteristics of an ordinal scale (which also includes a nominal scale) Plus It has a unit of measurement with an arbitrary starting and terminating point. • Measures with order and establishes numerically equal distances on the scale • In comparison to nominal and ordinal scale, the measurement on interval scale is needed to pass through three tests, i.e. (i) <i>Different numbers mean different things</i>, (ii) <i>Things being measured can be ranked or ordered along some dimension</i> and (iii) <i>The differences between adjacent levels on the scale are (are assumed to be) equal.</i>
Ratio	Height: cm Income: ₹ Age: years/months Weight: kg Attitudinal score: Guttman scale	<ul style="list-style-type: none"> • It has all the properties of a nominal scale, ordinal scale and interval scale Plus It has a fixed starting point, e.g. a zero point • Contains an absolute or true zero point in addition to an equal unit.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. While throwing light on the concept of measurement scales, name the different scales used for the measurement/assessment of learning or behavioural outcomes.
2. What are measurement scales? Discuss the four popular scales used for measurement in the field of education and psychology.
3. Discuss in detail the nature and application of any one of the following four scales of measurement
 - (a) Nominal scale (b) Ordinal scale (c) Ratio scale (d) Interval scale.

B. SHORT ANSWER TYPE QUESTIONS

1. Define the term scales of measurement.
2. Name the four scales used for measuring learning and behavioural outcomes of the students.
3. What is nominal scale/ordinal scale/interval scale/ratio scale?
4. Provide three examples of nominal data collected through the use of nominal scale.
5. What is ordinal data? Give two examples.
6. Name the scale that lies on the top in the hierarchy of measurement scales. Provide two examples of data collected through the use of this scale.
7. Tell what type of measurement scale is used for collecting one of the following four types of data.
 - (a) Gender and Religion of the students.
 - (b) Above average/average/below average income of the students.
 - (c) Performance on a standardized achievement test.
 - (d) Height and weight of the students.

Measures of Central Tendency, Percentiles and Percentile Rank

CHAPTER OUTLINE

- Introduction
- Arithmetic Mean (M)
 - Computation of Mean in the case of ungrouped data
 - Computation of Mean in the case of grouped data
- Median (M_d)
 - Computation of Median in the case of ungrouped data
 - Computation of Median in the case of grouped data
- Mode (M_o)
 - Computation of Mode in the case of ungrouped data.
 - Computation of Mode in the case of grouped data.
- Percentiles and Percentile Rank
- Study Questions

Introduction

If we take the achievement scores of the students of a class and arrange them in a frequency distribution, we can easily find that there are few students who either score very high or very low. The marks of most of the students lie somewhere between the highest and the lowest scores of the whole class. This tendency of a group of distribution is named as central tendency and the typical score lying between the extremes and shared by most of the students is referred to as a measure of central tendency. In this way, a measure of central tendency as Tate defines "is a sort of average or typical value of the items in the series and its function is to summarize the series in terms of this average value." (1955, p.78) The most common measures of central tendency are :

(i) Arithmetic mean or mean (ii) median and (iii) mode. Each of them, in its own way can be called a representative of the characteristics of the whole group and thus the performance of the group as a whole can be described by the single value which each of these measures gives. The values of mean, median or mode also help us in comparing two or more groups or frequency distributions in terms of typical or characteristics performance. In the following pages we will study these measures of central tendency.

Arithmetic Mean (M)

It is the simplest but most useful measure of central tendency. It is nothing but the 'average' which we compute in our High School Arithmetic and therefore can be easily defined as the sum of all the values of the items in a series divided by the number of items. It is designated by the symbol M.

Computation of Mean in the Case of Ungrouped Data

Let $X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}$ be the scores obtained by 10 students in an Achievement Test. Then the Arithmetic mean or Mean scores of the group of these students can be calculated as

$$M = \frac{X_1 + X_2 + X_3 + \dots + X_{10}}{10}$$

In this way, the formula for calculating mean of an ungrouped data is $M = \frac{\sum X}{N}$, where $\sum X$ stands for the sum of the scores or values of the items and N for the total number of items in a series or group.

Computation of Mean in the Case of Grouped Data (Data in the Form of Frequency Distribution).

(i) In frequency distribution where frequencies are greater than 1, the mean is calculated by the formula $M = \frac{\sum fX}{N}$, Where X represents the mid-point of class interval, f its respective frequency and N, the total of all the frequencies.

We can illustrate the use of this formula by taking the frequency distribution previously given in Table No. 4.2. of chapter 4th.

Scores	f	Mid-(Point) X	f X
65—69	1	67	67
60—64	3	62	186
55—59	4	57	228
50—54	7	52	364

45—49	9	47	423
40—44	11	42	462
35—39	8	37	296
30—34	4	32	128
25—29	2	27	54
20—24	1	22	22
			$\Sigma fX = 2230$

$$M = \frac{\Sigma fX}{N} = \frac{2230}{50} = 44.6$$

Arithmetic mean = 44.6

(ii) **Short cut method of computing the mean of grouped data.**
Mean for the grouped data can be computed easily with the help of the

following formula : $M = A + \frac{\Sigma f x'}{N} \times i$

where A stands for assumed mean, i for class interval, f for the respective frequency of the mid-value, N for the total frequency and x' for

$\frac{X - A}{i}$ (the quotient obtained after division of the difference between the mid-value of the class and assumed mean by i).

The use of this formula can be easily understood through the following illustration :

Let Assumed Mean (A) = 42

Scores	f	X	$x' = \frac{X - A}{i}$	fx'
65—69	1	67	5	5
60—64	3	62	4	12
55—59	4	57	3	12
50—54	7	52	2	14
45—49	9	47	1	9
40—44	11	42	0	0
35—39	8	37	-1	-8
30—34	4	32	-2	-8
25—29	2	27	-3	-6
20—24	1	22	-4	-4
				$\Sigma fx' = 26$

$$M = A + \frac{\Sigma fx'}{N} \times i = 42 + \frac{26}{50} \times 5 = 42 + 2.6 = 44.6$$

MEDIAN (M_d)

If the items of a series are arranged in ascending or descending order of magnitude, the measure or value or the central item in the series is termed the median. In this way as Bloomers and Lindquist define :

"The Median of a distribution is the point on the score scales below which one-half or 50 percent of the scores fall."

Thus, median is the score or value of the central item which divides the series into two equal parts. In this connection it should be clearly understood that central item itself is not the median. It is only the measure or value of the central item that is known as median. For example, if we arrange in ascending or descending order the marks of 5 students, then the marks obtained by 3rd student from either side will be termed as the median of the scores of the group of students under consideration.

Computation in the Case of Ungrouped Data.

There may arise two situations :

(i) When N (the number of items in series) is odd. In the case where N i.e. number of students in the above example, is odd (not divisible by 2) then the median can be computed by the formula

$$M_d = \text{The measure or value of the } \left(\frac{N+1}{2}\right)^{\text{th}} \text{ item.}$$

Example. Let the scores obtained by 7 students in an Achievement Test be 17, 47, 15, 35, 25, 29, 39, 44. Then first of all, for calculating median we have to arrange the scores in ascending or descending order like 15, 17, 25, 29, 35, 39, 44, 47. Here $N (= 7)$ is odd and therefore the score of the

$\left(\frac{N+1}{2}\right)^{\text{th}}$ or 4th student, i.e. 35 is the median of given scores.

(ii) Where N (the number of items in a series) is even— In the case where N is even (divisible by 2), then the median is determined by this following formula —

$$M_d = \frac{\text{The value of } (N/2)^{\text{th}} \text{ and } (N/2 + 1)^{\text{th}} \text{ item}}{2}$$

Example— Let there be a group of 8 students, whose scores are 17, 47, 15, 35, 39, 50, 44.

For calculating the median of these scores we will proceed as under

The score of the $(N/2)$ th = 35 i.e. 4th students

The score of the $(N/2 + 1)$ th = 39 i.e. 5th student

$$\text{Then Median} = \frac{35+39}{2} = 37.$$

Computation of Median in case of Grouped Data (data in the form of a frequency distribution).

If the data is available in the form of a frequency distribution like the following :

Scores	f
65—69	1
60—64	3
55—59	4
50—54	7
45—49	9
40—44	11
35—39	8
30—34	4
25—29	2
20—24	1
	N = 50

Then calculating of median first requires the location of median class. Actually as defined earlier, median is the measure or score of the central.

Therefore, it is needed which is the central item whose measure we aim to determine. It is done through the formula given above in the case of ungrouped data depending upon the odd and even nature of total frequencies (N). Here in the present distribution $N (= 50)$ is even, therefore, median will fall somewhere between the scores of 25th and 26th items in the given distribution. In the present example if we add frequencies from the above or below we can know that the class interval designated as 40—44 can be labelled as the class where the score representing median lies.

After estimating the median class the median of the distribution can be interpolated from the following formula :

$$M_d = L + \frac{N/2 - F}{f} \times i$$

Measures of Central Tendency

Where L = Exact lower limit of the median class

F = Total of all the frequencies before the median class

f = Frequency of the median class

i = Class interval

N = Total of all the frequencies

By applying the above formula we can compute the median of the given distribution in the following way

$$\begin{aligned} M_d &= 39.5 + \left(\frac{50/2}{11} \right) \times 5 = 39.5 + \frac{10}{11} \times 5 \\ &= 39.5 + \frac{50}{11} = 39.5 + 4.55 = 44.05 \end{aligned}$$

Some Special Situations in the Computation of Median

Let us think about the medians of the above distributions

(a) We know by definition that median is the point on the score scale below and above which 50% cases lie. Observing through this definition the score representing median should be a common score falling between the class 35—39 and 40—44. This score is nothing but the upper limit of the class 35—39 which is also the lower limit of the class 40—44. Therefore, in this case median is 39—5.

(b) In the 2nd distribution, if we try to add the frequencies from below we see that upto class interval 25—29, 13 cases lie and by adding frequencies from above we also find that upto the class interval 35—39, 13 cases lie. In this way, the class interval 30—34 divides the distribution into two equal parts below and above which 50% cases lie. It leads us to conclude that median should be the mid-point of the class interval 30—34 and therefore 32 is the median of this distribution.

(c) In the 3rd case if we add the frequencies from below we find that upto the class interval 6—7, 5 cases lie and by adding the frequencies from above. We also find that upto the class 12—13, 5 cases lie. The median should fall in the mid-way between the two classes 8—9, and 10—11. It should be the common score represented by both these classes. This score is nothing but the upper limit of the class 8—9 and lower limit of the class 10—11 and therefore, it should be 9.5.

MODE (M_o)

Mode is defined to be the size of the variable (say a score) which occurs most frequently. It is the point on the score scale that corresponds to the maximum frequency of the distribution. In any series it is the value of

the item, which is most characteristic or common and is usually repeated maximum number of times

Computation of Mode

(a) In the case of ungrouped data

In the case of ungrouped data mode can be easily computed merely by looking at it. All that one has to do is to find out the score which is repeated maximum number of times.

Example. Suppose we have to find out the value of the mode from the following scores of the students : 25, 29, 24, 27, 28, 25, 29.

Here the score 25 is repeated maximum number of times and thus value of the mode in this case is 25.

(b) In the case of grouped data

In the case where data is available in the form of a frequency distribution, the mode $(M_o) = 3M_d - 2M$ where M_d is the median and M , the mean of the given distribution of all mean as well as median of the distribution are computed and then with the help of the above formula Mode is calculated. For illustration we can take the distribution previously given in the Table 20.2. We know the mean and median of this distribution. Now we can use these results for the computation of the mode.

$$M_d = 44.05, \quad M = 44.6$$

$$\begin{aligned} \text{Therefore, } M_o &= 3 \times 44.05 - 2 \times 44.6 \\ &= 132.15 - 89.2 = 42.95 \end{aligned}$$

When to use the Mean, Median and Mode

Computation of any of the three—mean, median and mode—provides a measure of central tendency. Now which of them should be computed for a particular distribution is a question that can be raised quite often. Below we pay attention over this aspect in light of the characteristics and nature of all these measures.

(a) When to use the mean.

- (i) Mean is the most reliable accurate measure of the central tendency of a distribution in comparison to median and mode. It has the greatest stability as there are less fluctuations in the means of the samples drawn from the same population. Therefore, in the case where a reliable and accurate measure of central tendency is needed, we compute mean for the given data.
- (ii) Mean can be given an algebraic treatment and is better suited to further arithmetical computation. Therefore, it can be easily employed for the computation of various statistics like Standard Deviation,

Coefficient of correlation etc. Hence, when we need to know such statistics, mean is computed for the given data.

- (iii) In computation of the mean we give equal weightage to every item in the series. Therefore, it is affected by the value of each item in that series. Sometimes, there are extreme items which seriously affect the position of the mean. Therefore, it is not proper to compute mean for the series that have extreme items. It should be calculated only when the series has no extreme items and each score carries equal weight in determining the central tendency.
- (b) When to use the Median
- (i) Median is the exact mid-point of a series as 50% cases lie below and above it. Therefore, when the exact mid-point of the distribution is desired, median is to be computed.
 - (ii) Median is not affected by the extreme scores in the series. Therefore, when a series contains extreme scores, the median is perhaps the most representative central measure.
 - (iii) In case of an open end distribution (incomplete distribution "20 and above" or "20 and below" etc.) mean is impossible to be calculated.
 - (iv) Mean cannot be calculated graphically. But in case of median we can compute it graphically. Therefore, when we have suitable graphs like Frequency curve, Polygon etc. we should try to compute median.
 - (v) The median is specifically useful for the data the items of which cannot precisely be measured quantitatively e.g. qualities like health, culture, honesty, intelligence etc.
- (c) When to use the Mode
- (i) In many cases crude mode can be computed by just having a look at the data. It gives the quickest, although approximate, measure of central tendency. Therefore, in cases where a quick and approximate measure of central tendency is all that is desired, we compute mode.
 - (ii) Mode is that value of the item which occurs most frequently or is repeated maximum number of times in a given series. Therefore, when we need to know the most often recurring score or value of the items in a series, we compute mode. On account of this characteristic mode has unique importance in the large scale manufacturing of consumption goods. In finding the sizes of the shoes and ready-made clothes which will fit most men, the manufacturer makes use of the average indicated by mode.
 - (iii) Mode can be computed from the histogram and other frequency curves. Therefore, when we already have a graphical representation of the distribution in the form of such figures, it is appropriate to compute mode instead of mean.

Computation of Percentiles and Percentile Ranks

As we have discussed, median is the point on the score scale which divides the series into two equal parts such that 50% of the cases lie below and above it. Proceeding on the same principle, the series may be divided into hundred parts and the values of these items (scores) are known as percentiles. These value can be computed by the same procedure as adopted for computing median. Even the formula for computing percentiles is just similar to that of computing median. Below we are giving all these formulae along with the formula for computing median

$$M_d = L + \left(\frac{N/2 - F}{f} \right) \times i$$

$$\text{1st percentile or } P_1 = L + \left(\frac{N/100 - F}{f} \right) \times i$$

$$\text{50th percentile or } P_{50} = L + \left(\frac{50N/100 - F}{f} \right) \times i = L + \left(\frac{N/2 - F}{f} \right) \times i$$

75th percentile or

$$P_{75} = L + \left(\frac{75N/100 - F}{f} \right) \times i = L + \left(\frac{3N/4 - F}{f} \right) \times i$$

In all these formulae, L represents the lower limit of the class, where, approximately, the value or score of our required median or percentile lies ; N stands for the total of all frequencies ; F for the total of all the frequencies before this class ; f for the frequency of this particular class and i for the class interval. Now we illustrate the computation of different Percentiles by taking the following distribution :

Scores	f
70 - 79	3
60 - 69	2
50 - 59	2
40 - 49	3
30 - 39	5
20 - 29	4
10 - 19	3
0 - 9	2
	N = 24

(i) 10th Percentile (P_{10})

$$\text{Formula, } P_{10} = L + \left(\frac{N/10 - F}{f} \right) \times i$$

$$\text{Here } \frac{N}{10} = \frac{24}{10} = 2.4$$

It is easy to locate the P_{10} lying in the interval 10 - 19

$$\text{Thus } P_{10} = 9.5 + \left(\frac{2.4 - 2}{3} \right) \times 10 = 9.5 + \frac{4}{3} = 9.5 + 1.33 = 10.83$$

(ii) 25th Percentile (P_{25})

$$\text{Formula, } P_{25} = L + \left(\frac{25N/100 - F}{f} \right) \times i$$

$$= 19.5 + \left(\frac{25 \times 24}{100} \right) \times 10 = 19.5 + \frac{5}{2} = 22$$

(iii) 60th Percentile (P_{60})

$$\text{Formula, } P_{60} = L + \left(\frac{60N}{100} - F \right) \times i$$

$$\text{Here 60th percent of } 24 = \frac{60 \times 24}{100} = \frac{72}{5} = 14.4$$

Adding the frequencies from below we see that upto the upper limit of the class 30 - 39, 14 cases lie. Therefore 60th percentile of the distribution should fall in the interval 40 - 49.

$$\text{Hence } P_{60} = 39.5 + \left(\frac{14.4 - 14}{3} \right) \times 10 = 39.5 + 4/3 = 39.5 + 1.33 = 40.83$$

Computation of Percentile Rank

Before understanding the mechanism of computing percentile ranks from the raw scores of a group of students on such achievement/performance test, we should try to understand the difference between percentiles and percentile rank.

What are percentiles and percentile rank ?

As matter of definition, a percentile may be known as a point on the distribution or score scale below which a given per cent of the cases lies.

Defined in this way, the 1st percentile (written as P_1) will mean "a score point in the given series or distribution below which 1 per cent cases lie and above which 99 per cent cases lie." Similarly, the 70th percentile (P_{70}) will reveal a score point in a given series or distribution below which the scores of 70 per cent and above which 30 per cent members of the group fall.

As a matter of definition, the term percentile rank may be defined as the number representing the percentages of the total number of cases falling below the given score in a particular distribution. In such a sense, a percentile rank gives a person's relative position or the percentage of individuals' scores falling below his obtained score. For example, let us assume that Ramesh has obtained a raw score of 65 on a Mathematics test. If 80 per cent of the scores in the distribution fall below a score of 65, the percentile rank of the score of 65 is 80 and the 80th percentile is a score of 65. Thus, 65 is the point below which 80 per cent of the scores in the distribution falls. (You may conclude that percentile ranks and percentiles are just opposite to each other.)

In the light of the above clarification about the concept of percentile and percentile rank, we may form an opinion about the way of converting a raw score into a percentile rank/norm in the following manner:

1. Take the raw score (obtained on a test) that you need to get converted into a percentile rank or norm. Let it be 25.
2. Calculate the percentages of the subjects (belonging to a standardized sample) whose scores lie below the score 25. Let it be 30 per cent.
3. Then 30 will be regarded as the percentile rank or norm of the raw score of 25.

A Few important clarifications about the concept of percentiles and percentile ranks

1. Percentile ranks or norms can also be regarded as ranks in a group of 100, except that in ranking it is customary to start counting at the top, the best person in the group receiving a rank of one. With percentiles, on the other hand, we begin counting at the bottom, so that the lower the percentile, the poorer the individual's standing (Anastasi, 1968:49)
2. These should not be confused with our well-known percentage scores. It must be remembered that where percentiles are derived scores, expressed in terms of the percentages of the persons falling below a given score belonging to a particular distribution, the percentage scores are raw scores, expressed in terms of the correct items.
3. In explaining a norm percentile rank of 95 earned by a student in the CBSE examination of national level, it may be said that he has

obtained a score higher than 95 per cent of the students appearing in the examination.

4. A raw score higher than any score in the standardization sample would have a percentile rank of 100 (P_{100}), while that lower than any obtained in the standardized sample would have a percentile rank of zero (P_0). These percentiles, however, should not be confused in any case with a perfect raw score and a zero raw score.

How to compute percentile norms with a given distribution

Table 15.1 Frequency distribution of the scores earned by the subjects in a given test

Scores	f
70 - 79	3
60 - 69	2
50 - 59	2
40 - 49	3
30 - 39	5
20 - 29	4
10 - 19	3
0 - 9	2
	N = 24

Method 1: Involving the use of a generalized formula

The percentile rank or norm of a given raw score of a distribution (organized in of a frequency table) may be easily computed by employing the following formula:

$$PR = 100/N \{F + [(X - L)/i] \times f\}$$

where PR = Percentile rank for the desired score X

F = Cumulative frequency below the interval containing score X

X = Score for which we want the percentile rank

L = Actual lower limit of the interval containing X

i = Size of the class interval

f = Frequency of the interval containing X

N = Total number of the cases in the given frequency distribution.

Let us use this formula to compute the percentile rank of the score 22 belonging distribution given in Table 15.1

Percentile rank of the score 22:
 $PR = 100/24 (5 + 22 - 19.5/10 \times 4) = 100/24 (5 + 2.5 \times 4/10)$
 $= 100 \times 6/24 = 25$

Method 2: Use of cumulative frequency curve or ogive

Percentile points and percentile ranks both may be read with a high degree of accuracy from an ogive (a cumulative percentage frequency graph) accurately constructed on a graph sheet. Most of the test manuals contain ogive (showing the cumulative percentage of cases falling below each score) for the easy computation and interpretation of percentile norms.

For the purpose of illustration we are here producing a smoothed ogive. See figure 15.1.

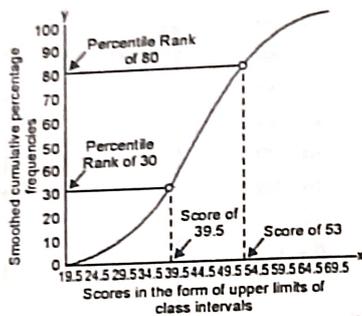


Fig. 15.1. Computation of percentile ranks or norms from an ogive.

How to read the percentile rank or norm from the ogive

For reading the percentile rank or norm of a given score lying on the X-axis, one can proceed as under

1. Draw perpendicular lines from the points (where the given raw scores are lying on the X-axis) extending to the ogive curve. Here in Figure 15.1, two such perpendicular lines have been drawn for the scores 39.5 and 53 lying on the X-axis.
2. Draw horizontal lines from the points where the perpendiculars intersect the ogive on the Y-axis (showing cumulative percentage frequencies).
3. You will get the points on the Y-axis indicating the corresponding percentile ranks or norms of the given raw scores.
4. In Figure 15.1 now you may see that a raw score of 39.5 has a percentile rank of 30 and a score of 53.00 has a percentile rank of 80.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. What do you mean by measures of central tendency? Name different measures of central tendency and discuss them in brief.
2. What is Arithmetic Mean (M)? How is it computed in the cases of ungrouped and grouped data? Discuss with hypothetical examples.
3. What is Median (M_d)? How is it computed in the cases of ungrouped and grouped data? Discuss with the help of a hypothetical example.
4. What is mode (M_o)? How is it computed in the cases of ungrouped and grouped data? Discuss with the help of a hypothetical example.
5. Explain which of the three mean, median and mode should be computed for a particular distribution in a specified situation.
6. Compute Median for the following Ungrouped data :
 (i) 16, 2, 10, 9, 4, 7, 12, 14, 15
 (ii) 8, 3, 10, 5, 2, 11, 14, 12
Ans. (i) 10 (ii) 9
7. Find the crude Mode for the following data :
 15, 14, 8, 14, 14, 11, 9, 9, 11.
Ans. 14
8. Compute the Mean, Median and Mode for the following distributions :

(a)	(b)	(c)	(d)
Scores	Scores	Scores	Scores
73—71	120—122	45—49	135—144
68—69	117—119	40—44	125—134
66—67	114—116	35—39	115—124
64—65	111—113	30—34	105—114
62—63	108—110	25—29	95—104
60—61	105—107	20—24	85—94
58—59	102—104	15—19	75—84
56—57	99—101	10—14	65—74
54—55	96—98	5—9	55—64
52—53	93—95	0—4	
50—51	90—92		
	N=36	N=40	N=100

Ans.

(a)	(b)	(c)	(d)
M = 61.11	M = 106.00	M = 25.05	M = 99.3
M _d = 61.21	M _d = 105.83	M _d = 25.17	M _d = 99.3
M _o = 61.41	M _o = 105.49	M _o = 25.41	M _o = 99.3

9. Calculate the Mean, Median and Mode of the following frequency distribution :

Class Interval	Frequency
195 - 199	1
190 - 194	2
185 - 189	4
180 - 184	5
175 - 179	8
170 - 174	10
165 - 169	6
160 - 164	4
155 - 159	4
150 - 154	2
145 - 149	3
140 - 144	1

Ans. $M = 170.8$, $M_d = 172$, $M_o = 174.4$

10. Calculate the mean, Median and Mode of the following distribution.

Class Interval	35-39	30-34	25-29	20-24	15-19	10-14
Frequency	4	8	15	10	8	5

Ans. $M = 24.5$, $M_d = 28.83$, $M_o = 34.79$

11. What are percentiles ? Illustrate with the help of an hypothetical example the procedure of computation of percentiles.
12. What are percentile Ranks ? How these are computed for the scores earned in an achievement test ? Explain with an example.

B. SHORT ANSWER TYPE QUESTIONS

1. What are the measures of central tendency ? Name their various types.
2. What is mean ? How is it computed ?
3. What is median ? How is it computed ?
4. What is mode ? How is it computed ?
5. When and where is the need of the computation of mean for a given data ?
6. When and where is the need of the computation of median for a given data ?
7. When and where is it useful to compute mode in the case of a given data ?
8. What are percentile ?
9. What are percentile ranks ? How these are computed ?

Measures of Variability of Dispersion

CHAPTER OUTLINE

- Need of the measures of variability or dispersion
- Different measures of variability or dispersion
- Range (R)
- Quartile Deviation (Q)
- Average Deviation (AD)
 - Computation of Average Deviation from ungrouped data
 - Computation of Average Deviation from grouped data
- Standard Deviation (S.D.)
 - Computation of Standard Deviation from ungrouped data
 - Computation of Standard Deviation from grouped data
- Study Questions

Need of the Measures of Variability or Dispersion

Measures of central tendency—mean, median and mode—provide central value or typical representative of a set of scores as a whole. Through these measures we can represent a characteristic or quality of the whole group by a single number. By comparing such typical representative of the different sets of scores we can compare the achievement of the two groups. But these representative numbers give us merely an idea of the general achievement of the group as a whole, and does not show how the individual scores are spread out. Therefore, through measures of central tendency we are unable to know much about the distribution of scores in a series or characteristics of items in a group. Hence, measures of central tendency provide insufficient base for the comparison of two or more frequency distributions or sets of scores. It can be made more clear from the following example :

Let there be two small groups of boys and girls whose scores in an achievement test are such as the following :

Test Scores of Group A (boys)—40, 38, 36, 17, 20, 19, 18, 3, 5, 4.

Test Scores of Group B (girls)—19, 20, 22, 18, 21, 23, 17, 20, 22, 18.

Now the value of the Mean in both the cases is 20 and thus, so far as the mean goes, there is no difference in the performance of the two groups. Now the question arises, can we take both sets of scores as identical? Definitely there is a lot of difference between the performance of two groups. Whereas the test scores of group A are found to range from 30 to 40, the scores in group B range from 18 to 23. First group is composed of individuals who have wide individual differences. It contains either very capable or very poor individuals. The second group, on the other hand, is composed of average individuals. Individuals in this latter group are less variable than those of the former. Looking in this way, there is a great need of paying consideration to the variability or dispersion of the scores in the sets of scores or series if we want to describe and compare them.

Different Measures of Variability or Dispersion

There are chiefly, four measures of indicating variability or dispersion within the set of scores. They are :

- (a) The Range (R) (b) The Quartile Deviation (Q)
(c) The Average Deviation (AD) (d) The Standard Deviation (SD)

Each of the above measures of variability gives us the degree of variability or dispersion by the use of a single number and tells us how the individual scores are scattered or spread over throughout the distribution or gives data.

In the following pages we will discuss these measures in brief.

Range (R)

Range is the simplest measure of variability or dispersion. It is calculated by subtracting the lowest scores in the series from the highest. But it is very rough measure of the variability of a series. It takes only extreme scores into consideration and tells nothing about the variation of the individual items.

Quartile Deviation (Q)

It is computed by the formula $Q = (Q_3 - Q_1)/2$, where Q_1 and Q_3 represent the 1st and 3rd Quartiles of the distribution under consideration. The amount Q_3 and Q_1 is nothing but the difference or range between 3rd and 1st Quartile. It is designated as the inter quartile range. For computing Quartile Deviation, this interquartile range is divided by 2 and therefore, Quartile Deviation is also named as semi-interquartile range. In this way

for computing Q , the values of Q_1 and Q_3 are first determined and then by applying the above formula we try to get the value of Quartile Deviation.

Average Deviation (AD)

"Average Deviation or AD " as Garrett defines it, "is the mean of the deviation of all the separate scores in the series taken from their mean (occasionally from the median or mode)" (1971, p. 481)

It is the simplest measure of variability that takes into account the fluctuation or variation of all the items in a series.

(i) Computation of Average Deviation (AD) from ungrouped data.

In the case of ungrouped data AD is calculated by the formula

$$AD = \frac{\sum |x|}{N}$$

where $x = X - M =$ Deviation of the score from the mean of the series and x signifies that in the deviation values we ignore the algebraic signs +ve and -ve.

The use of this formula can be explained through the following example.

Problem. Find out the Average Deviation of the scores 15, 10, 6, 8, 11 of a series.

Solution. The mean of the given series = $15 + 10 + 6 + 8 + 11 = 10$

Scores X	Deviation from the Mean $(X - M) = x$	$ x $
15	5	5
10	0	0
6	-4	4
8	-2	2
11	1	1
$N = 5$		$\sum x = 12$

By applying the formula $AD = \frac{\sum |x|}{N} = \frac{12}{5} = 2.4$

(ii) Computation of Average Deviation from grouped data

From grouped data $A.D.$ can be computed by the formula

$$A.D. = \frac{\sum |fx|}{N}$$

Use of this formula can be understood through the following illustration :

Scores	f	Mid-Point X	fX	$x = X - M$	fx	$ fx $
110-114	4	112	448	11.94	44.76	47.76
105-109	4	107	428	6.94	27.76	27.76
100-104	3	102	306	1.94	5.82	5.82
95-99	0	97	0	-3.06	0	0
90-94	3	92	276	-8.08	-24.18	24.18
85-89	3	87	261	-13.06	-39.18	39.18
80-84	1	82	82	-18.06	-18.06	18.06
	$N = 18$		$\Sigma fX = 1801$			$\Sigma fx = 162.67$

First of all Mean is computed.

$$\text{Here Mean} = \frac{\Sigma fx}{N} = \frac{1801}{18} = 100.06$$

Then we calculate the values of x by subtracting Mean from the respective values of X and enter them into V column. By multiplying these values by the respective class frequencies and ignoring the algebraic sign we get the value of $\Sigma |fx|$. Afterwards we apply the formula as below :

$$AD = \frac{\Sigma |fx|}{N} = \frac{162.76}{18} = 9.04$$

Standard Deviation (SD)

Standard Deviation of a set of scores is defined as the square root of the average of the squares of the deviations of each score from the mean.

$$\text{Symbolically we can say that } SD = \sqrt{\frac{\Sigma (X - M)^2}{N}} = \sqrt{\frac{\Sigma x^2}{N}} \text{ where } X$$

stands for individual score, M for mean of the given set of scores, N for total number of the scores and x for the deviation of each score from the mean.

Standard Deviation is regarded as a most stable and reliable measure of variability as it employs mean for its computation. It is often called as Root-mean square deviation and is denoted by the Greek letter sigma.

(a) Computation of Standard Deviation (SD) from Ungrouped data. SD can be computed from the ungrouped scores by the following

$$\text{formula } \sigma = \sqrt{\frac{\Sigma x^2}{N}}$$

Below we illustrate the use of this formula by taking a particular example.

Problem. Calculate SD for the following set of test scores

52, 50, 56, 68, 65, 62, 57, 70

Solution. Mean of the given scores = $480/8 = 60$

Scores X	Deviation from the mean $(X - M)$ or x	Squares of the Deviations x^2	
52	-8	64	Now $\sigma = \sqrt{\frac{\Sigma x^2}{N}}$ $= \frac{\sqrt{382}}{8}$ $= \sqrt{47.75}$ $= 6.91$
50	-10	100	
56	-4	16	
68	8	64	
65	5	25	
62	2	4	
57	-3	9	
70	10	100	
		$\Sigma x^2 = 382$	

(b) Computation of SD from Grouped data. S.D. in case of grouped data can be computed by formula

$$\sigma = \sqrt{\frac{\Sigma fx^2}{N}}$$

The use of the formula can be understood through the solution of the following example.

Problem. Compute SD for the frequency distribution given below on the extreme left. The mean of this distribution is 115.

I.Q. Scores	f	X	M	x	x^2	fx^2
127—129	1	128	115	13	169	169
124—126	2	125	115	10	100	200
121—123	3	122	115	7	49	147
118—120	1	119	115	4	16	16
115—117	6	116	115	1	1	6
112—114	4	113	115	-2	4	16
109—111	3	110	115	-5	25	75
106—108	2	107	115	-8	64	128
103—105	1	114	115	-11	121	121
100—102	1	101	115	-14	196	196
	$N = 24$					$\sum fx^2 = 1074$

$$\text{Now } \sigma = \sqrt{\frac{\sum fx^2}{N}} = \sqrt{\frac{1074}{24}} = \sqrt{44.75} = 6.69$$

In the above computation work we have made use of M , the mean of the distribution. If not given in the problem, it can be computed in the following way :

Calculation of mean — Let Assumed Mean be 116

Scores	f	X (Mid-Value)	$x' = \frac{x - A}{i}$	fx'
127—129	1	128	4	4
124—126	2	125	3	6
121—123	3	122	2	6
118—120	1	119	1	1
115—117	6	116	0	0
112—114	4	113	-1	-4
109—111	3	110	-2	-6
106—108	2	107	-3	-6
103—105	1	104	-4	-4
100—102	1	101	-5	-5
	$N = 24$			$fx' = -8$

$$\text{Formula } M = A + \frac{\sum fx'}{N} \times i$$

$$= 116 - \frac{8}{24} \times 3 = 116 - 1 = 115$$

Mean = 115.

(c) Computation of SD from grouped data by Short-cut Method :
SD from grouped data can also be computed by the following formula

$$\sigma = i \sqrt{\frac{\sum fx'^2}{N} - \left(\frac{\sum fx'}{N}\right)^2}$$

Where the notation have the same meaning as desired earlier. The use of this formula can be explained by solving the problem given under the case (b).

I.Q. Scores	f	X	$x' = \frac{X - A}{i}$	fx'	fx'^2
127—129	1	128	4	4	16
124—126	2	125	3	6	18
121—123	3	122	2	6	12
118—120	1	119	1	1	1
115—117	6	116	0	0	0
112—114	4	113	-1	-4	4
109—111	3	110	-2	-6	12
106—108	2	107	-3	-6	18
103—105	1	104	-4	-4	16
100—102	1	101	-5	-5	25
	$N = 24$			$\sum fx' = -8$	$\sum fx'^2 = 122$

$$\text{Formula } \sigma = i \sqrt{\frac{\sum fx'^2}{N} - \left(\frac{\sum fx'}{N}\right)^2}$$

$$= 3 \sqrt{\frac{122}{24} - \left(\frac{-8}{24}\right)^2}$$

$$= 3 \sqrt{\frac{122}{24} - \frac{64}{24 \times 24}}$$

$$= \frac{3}{24} \sqrt{122 \times 24 - 64}$$

$$= \frac{1}{8} \sqrt{2864} = \frac{53.51}{8}$$

Standard Deviation = 6.69

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. What do you understand by dispersion or variability of the scores in a given series? Discuss in brief the different measures of variability.

2. Calculate average Deviation from the following Data :

(a) Scores 30, 35, 36, 42, 44, 46, 38, 34, 35

(b) Scores	<i>f</i>
80—84	4
85—89	4
90—94	3
95—99	0
100—104	3
105—109	3
110—114	1

$N = 18$

Ans. (a) 3.9

(b) 2.04

3. Calculate standard deviation for the ungrouped data under the above problems (a).

Ans. 4.68

4. Compute Standard Deviation for each of the four frequency distributions a, b, c, d, given in problem 8 of the chapter 15

Ans. (a) 4.99, (b) 7.73,
(c) 7.7, (d) 13.4

5. What are the measures of variability or dispersion? Discuss the need of their computation.
6. What is average deviation? Discuss the procedure of its computing from the ungrouped as well as the grouped data with the help of an hypothetical examples.
7. What is Standard Deviation? Discuss the procedure of its computation from the ungrouped as well as grouped data with the help of some hypothetical data.
8. Calculate mean and Standard Deviation for the following data.

Scores	<i>f</i>
60—69	4
50—59	4
40—49	4
30—39	10
20—29	8
10—19	5
0—9	5

Ans. $M = 36.75$, $S.D. = 17.815$,

9. Compute Mean and Standard Deviation for the following data.

(a) Scores	<i>f</i>	(b) Scores	<i>f</i>	(c) Scores	<i>f</i>
45—49	2	90—93	1	85—87	1
40—44	3	86—89	3	82—84	3
35—39	2	82—85	8	79—81	2
30—34	6	78—81	5	76—78	3
25—29	8	74—77	7	73—75	3
20—24	8	70—73	6	70—72	2
15—19	7	66—69	4	67—69	2
10—14	5	62—65	2	64—66	3
5—9	9			61—63	1

Ans. (a) $M = 22.4$, $S.D. = 11.3$

(b) $M = 77.06$, $S.D. = 7.13$

(c) $M = 74.15$, $S.D. = 6.936$

10. Compute Quartile Deviation from the following data.

(a) Scores	f	(b) Scores	f
45-49	2	135-144	1
40-44	3	125-134	2
35-39	2	115-124	8
30-34	17	105-114	22
25-29	30	95-104	33
20-24	25	85-94	22
15-19	15	75-84	9
10-14	3	65-74	2
5-9	2	55-64	1
0-4	1		

Ans. (a) 4.5

(b) 8.85

B. SHORT ANSWER TYPE QUESTIONS

1. What is a range as a measure of variability? Illustrate its computation through an example.
2. What are the measure of variability or dispersion? Name the various measures of variability.
3. What is quartile deviation? How is it computed? Explain with the help of an example.
4. Tell about the average deviation as a measure of variability.
5. Tell about the standard deviation as a measure of variability.
6. Write short note on the need of computing measure of variability or dispersion.

Normal Distribution and Standard Scores

CHAPTER OUTLINE

- What is a Normal distribution and Normal curve?
- Characteristics and properties of a Normal curve.
- An Illustration of the concept of Normal distribution and curve
- Standard Scores – Concept and Computation
 - Need and Importance of Standard Scores
 - Z scores and Sigma Scores
 - T scores
 - Stanine Scores
- Study Questions

What is a Normal Distribution and Normal Curve?

The literal meaning of the term normal is average. We have made use of this term in chapter five of the text while computing the average or mean value from the data related to various assessment & devices like achievement tests, psychological tests, inventories and rating scales. Those who attain this mean value are termed as normal, while whose scores fall below and above this value are termed as above and below averages in terms of the quality or characteristics assessed by that test or tool.

If we try to analyse the data device from an assessment device for a population of the students, we may notice that these lies a lot of differences among their scores. However, much of the data collected from the achievement and psychological tests and tools follow the pattern and rules of a normal distribution. Let us see what do we mean by the term normal distribution. Nature have been kind enough to distribute quite equally most of the things and attributes like height weight, wealth, beauty, intelligence and the like among the population in a normal way. The same is also true for the distribution of the achievement and performance scores through the

use of one or the other assessment tool or devices in the field of school education.

If we plot such a distribution of data (referred to as normal distribution) on a graph paper we would get an interesting typical curve often resembling a vertical cross section of a bell shown in the fig. 17.1. below. This bell shaped curve is called a normal curve.



Fig. 17.1. Normal Curve

Characteristics and Properties of a Normal Curve

1. For this curve, mean, median and mode are the same.
2. The curve is perfectly symmetrical
3. The curve is asymptotic. It approaches but never touches the base line at the extremes because of the possibility of locating in the population, a case which scores still higher than our highest score or lower than our lowest score. Therefore, theoretically, it extends from minus infinity to plus infinity.
4. As the curve does not touch the base line, the mean is used as the starting point for working with the normal curve.
5. The curve has its maximum height or ordinate at the starting point, i.e., the mean of the distribution.
6. To find the deviations from the point of departure (i.e., mean), standard deviation of the distribution (σ) is used as a unit of measurement.
7. The curve extends on both sides -3σ distance on the left to $+3\sigma$ distance on the right.
8. The points of inflection of the curve occur at ± 1 standard deviation unit ($\pm 1\sigma$) above and below the mean. Thus the curve changes from convex to concave in relation to the horizontal axis at these points.

9. The total area under the curve extending from -3σ to $+3\sigma$ is taken arbitrarily to be 10,000 because of the greater ease in the computation of the fractional parts of the total area found for the mean and the ordinates erected at various distances from the mean. The computation of such fractional parts of the total area for travelling desired σ distances from the mean may be conveniently made with the help of a table given in all the text books of educational statistics
10. We may find that 3413 cases out of 10,000 or 34.13% of the entire area of the curve lies between the mean and $+1\sigma$ on base line of the normal curve. Similarly, another 34.13% cases lie between the mean and -1σ on the base line. Consequently, 68.26% of the area of the curve falls within the limits ± 1 Standard deviation ($\pm 1\sigma$) unit from the mean. Going further it may be found out that 95.44% cases lie from -2σ to $+2\sigma$ and 99.74% cases lie from -3σ to $+3\sigma$. Consequently only 26 cases in 10,000 (10,000 - 9974) should be expected to lie beyond the range $\pm 3\sigma$ in a large sample as shown in Fig. 17.2.

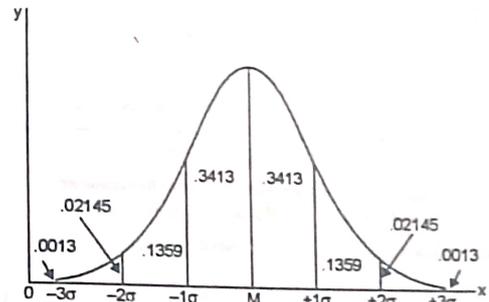


Fig. 17.2. Normal curve showing areas at different distances from the mean.

An Illustration of Concept of Normal Distribution and Curve

Let us try to illustrate the concept of normal distribution and normal curve with hypothetical data related with the distribution of the achievement scores over a given population of the examinees.

For having a large sample of population of the examinees let us approach the Board of School Examination, of a state for the record of the last year XII class annual examination. We may have the total marks scores of all the examinees appearing in the said examination arranged serially

according to their roll numbers. Out of this huge data we can randomly select the total marks scores of 10000 students for our study. Let us now calculate the average score or mean value of the sample. For this purpose, we will add individual total marks of these 10000 students and then divide it by 10000 for getting mean or average score value for the sample. If we try to analyse the total marks earned by this population of 1,00,00, we will find that majority of them have either earned the mean average score or lie quite near to this value. There are very few who have earned distinction marks or got very low marks. In case we try to plot the total marks (scores) earned by these 10000 students on a sheet of graph paper by taking scores on x-axis and no. of students earning these scores (frequencies) on y-axis, we can have a bell-shaped curve (shown in fig. 17.3).

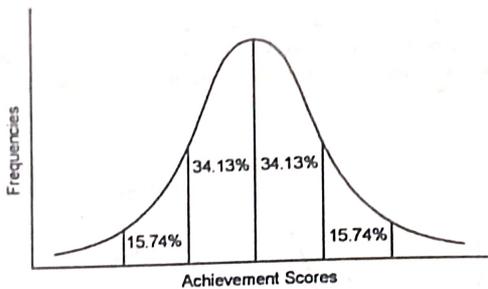


Fig. 17.3. The distribution of achievement scores in a population of examinees.

Let us analyse the pattern of the distribution of achievement scores in the population of examinees.

1. As revealed by this curve, we can locate the majority, 34.13% + 34.13%, i.e., 68.26% of the students either getting marks equal to the mean average value or lying quite nearer to this value. This sub-population of 6826 out of 10000 thus can be declared as normal, i.e., the students who possess normal or average academic achievement of abilities.
2. The curve shows that there are 15.74% of the students who have earned more marks than the average. This 15.74% sub-population of the students, i.e., 1574 out of 10000, is named as above average in terms of their academic achievements. A similar percentage, i.e., 15.74% of the students also lie on the other side of the mean value. It

shows that there are 15.74% students, i.e. 1574 out of 10000, who have got less marks than the average value. These students are named as below average or sub-normals in respect to their academic achievement in XII class final examination.

3. The normal curve thus can portray the pattern of distribution of an attribute in a given population. Here it has demonstrated that out of 10000, the majority 68.26%, i.e., 6826 out of 10000 consists of averages. There are only 15.74%, i.e., 1574 out of 10000 who are below average and a similar percentage 15.74%, i.e., 1574 out of 10000 who are labelled as above average.

In the light of above findings and analysis we can easily conclude that distribution of assessment scores in a given population follows the pattern of a normal curve.

Standard Scores -Concept and Computation

Need and Importance of Standard Scores

From educational and psychological assessment quite often we obtain numerical scores for assessing the ability and capacity of students. These scores are termed as *raw scores*. The mere knowledge of these raw scores obtained from different tests is quite insufficient to make comparisons-inter-individual (comparing a person's score with these scores of others) or intraindividual (within the individual). Let us illustrate this with an example.

For a vocational course entrance test, a group of students were given some intelligence subtests and aptitude tests. The findings for two students were as given in Table 17.1.

Table 17.1. Raw Scores Obtained by Two Students in Entrance Test

Name of student	Verbal ability	Numerical ability	Perceptual ability	Mechanical aptitude	Artistic aptitude
Ramesh	28	26	30	17	35
Rakesh	17	32	16	30	40

1. Let us analyze first the intraindividual comparison. From the raw scores given above, it is not possible to have intraindividual comparisons. Ramesh who obtained 35 in artistic aptitude and 17 in mechanical cannot be called better in artistic aptitude unless we have some way of finding at the comparative scores. The mechanical aptitude test scores can be compared with the scores in artistic aptitude test only if we transfer these raw scores into some standard scores

having a relative meaning. Similar is the case with the raw scores obtained in different sub-tests of mental ability. We cannot say Ramesh is better in verbal ability than in numerical ability. The scales of measurement must be comparable. Here, the scores on these two aptitude tests make different sets of distribution. Unless we convert these distributions into a common distribution (in most cases it may be normal distribution), we cannot have a common or a comparable scale for making relative comparisons.

2. Similarly, we cannot have inter-individual comparisons with the help of the data given in raw scores. For instance, let us take the case of mental abilities. Who is better between Ramesh and Rakesh, with regard to the performance in various sub-tests? Can we add the scores obtained in various sub-tests and then make comparison on the basis of the total obtained? Obviously, the answer is No, unless we convert the raw scores into some common or standard scores. The units of a common scale can only be added. Here, raw scores obtained in various sub-tests can only be added in case these are first converted into scores of relative value, *i.e.*, measures on some common scale. Similarly, we cannot say Ramesh is better in perceptual ability than in mechanical or numerical unless we have a common scale for the measurement of these abilities.

In this way, scores obtained by an individual in different tests and sub-tests or by individuals for assessing a particular trait or an ability with the help of different types of tests or sub-tests can only be compared if these raw scores are transformed into scores of relative meanings or a scale of common measure.

Thus, for making inter-individual or intraindividual comparisons, the raw scores obtained in some educational assessment are to be transformed into some standard scores or scores of relative meaning. The most general and frequently used derived or transformed scores in education are the following :

- (i) Z scores or sigma scores
- (ii) T scores and stanine scores

Let us discuss them in detail.

z Scores or Sigma Scores

In a distribution, deviations of the scores from its mean expressed in σ (sigma, *i.e.*, standard deviation of the distribution) units are called z scores or sigma scores. The z score or σ score is the basic standard score. A converted z score or σ score of any raw score tells us where and how far

above or below the mean that particular score lies in the distribution since most of the distributions of the scores obtained from educational and psychological tests are normal or nearly normal. Moreover, a test developer, while standardizing a test, tries to make use of a large sample and, as a result, the scores obtained on the test comprise a normal distribution. Therefore, it is appropriate to assume normality for any set of raw scores (obtained on the standardized test) that we need to transform into z or sigma scores. However, for making the concept of z score or sigma scores more clear, let us talk about the normal curve and characteristics of normal distribution.

If we plot the raw scores of a standardized test on the X-axis and their frequencies on the Y-axis, we will get a bell-shaped curve, *i.e.*, normal curve. The curve has two identical divisions, with the mean of the distribution as its centre or starting point. The distance from the mean, the starting point for both the directions (negative or positive) are measured in σ (the standard deviation of the distribution) units. Then the distances from the mean can be equally subdivided, ranging from -3σ (or more) to $+3\sigma$ (or more), as shown in Fig. 17.4.

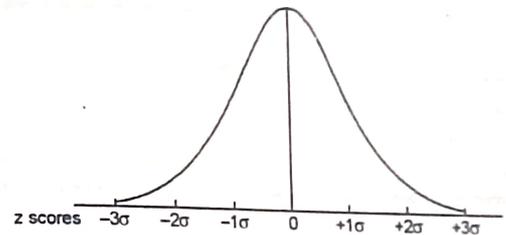


Fig. 17.4. z scores expressed in σ units with their mean as zero.

Since z or σ scores are deviations of the scores from the mean and are expressed in units, it is imperative that the mean of the z scores essentially be zero and their standard deviation be equal to one. This is the reason why the mean (zero) serves as the starting point (the origin) and standard deviation with its value 1 becomes the unit of measurement. Here, any score is interpreted in terms of the negative or positive distances (in σ units) from the mean. In this way, z scores may be considered to make use of the type of scale referred to as the zero plus or minus scale for the conversion of the raw scores into standard scores. That is why the raw scores converted into standard scores on the zero plus or minus scale are more popularly referred to as z scores or σ scores (Cohen and Swerdlik, 2005 : 86).

How to convert raw scores into z scores or σ scores

For converting raw scores belonging to a distribution into a z score, one can proceed as under.

1. First compute the mean (M) and standard deviation (σ) of the distribution.
2. Then substitute the value of M and σ in the following formula for computing z score: $z = (X - M)/\sigma$ (where X stands for raw score)

Application and use of z scores

Conversion of raw scores into z scores may be successfully used for making comparisons on different tests. This fact may be illustrated through an example given below.

Example : There are two sections A and B in class IX of a school. To test their achievement in Maths, two different question papers were prepared. Ramesh, a student of section A got 80 marks, while Suresh, a student of section B, got 60. Can you say which of these two students stood better in terms of achievement in Maths ?

Mean and SD of the distribution of scores for section A and B are as follows :

Section A	Section B
Mean = 70	Mean = 50
SD = 20	SD = 10

Solution. Here we cannot conclude that Ramesh with 80 marks is a better student in Maths as compared to Suresh who has earned only 60 marks. The paper set for section A might have been quite easy; or, it could have contained objective type questions or so many other variations in contrast to those in Section B. As a result, the marks obtained by these two students do not belong to the same scale of measurement. Their raw scores, need to be transformed into some common standard scores such as z scores for comparison. Let us do so.

The formula for transformation is as follows :

$z = (X - M)/\sigma$ (where X = Raw score, M = Mean of the distribution of the raw scores in a test and σ = Standard deviation of the scores of the test)

Therefore, z scores of Ramesh = $(80 - 70)/20 = 10/20 = 0.5$

And z scores of Suresh = $(60 - 50)/10 = 10/10 = 1.0$

Here we can conclude now that Suresh is placed better (with 1σ score) in terms of his achievement compared to Ramesh (with 0.5σ score).

Normal Distribution and Standard Scores

Merits and limitations of z scores

The merits of z scores are as follows :

1. z scores have essentially the same meaning for all tests and subtests, hence we can add them for taking a composite view of the performance or capability of the individual/individuals.
2. Transformation of raw scores into z scores does not change the shape or characteristics of the distribution.
3. z scores can be safely used for infra-individual and inter-individual comparisons.

The limitations of z scores are as follows :

1. In these z scores, plus and minus signs are used. These can be overlooked, miscopied or misunderstood.
2. Decimal points used may create difficulty in interpretation of the test results.

T Scores

In the scale of measurement involving z or σ scores, the starting point is the mean of the distribution, i.e., zero, and the unit of measurement is 1σ (standard deviation of the distribution) (see Figure 17.5). Travelling from zero on this scale to both sides may involve minus and plus signs and the unit of measurement, 1σ may carry decimal points. It is inconvenient for the users to think or work in terms of negative and fractional quantities. To overcome such limitations of z scores, a more useful scale named T scale may be used. This scale allows us to get rid of the need to use decimal points by multiplying every z score by some convenient constant such as 10, and also to get rid of minus signs by adding a convenient constant amount, such as 50.

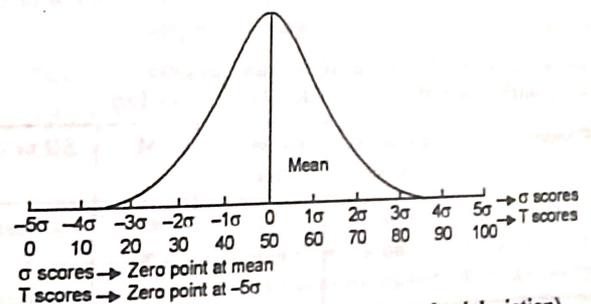


Fig. 17.5. T scale (with T points and standard deviation).

This scale was derived and first used by William A. McCall and named as T scale in the honour of Thorndike and Terman. In this scale, McCall made use of another type of scores, slightly different from the z or σ scores. These T scores may be defined as normalized standard scores or derived scores converted into a distribution with a mean of 50 and standard deviation of 10.

Thus, in sharp contrast to the scale of measurement used for z or σ scores, in the scale of measurement for T scores, the starting point (0) is placed 5 standard deviation below the mean, and the finishing point (100) 5 standard deviation above the mean. The scale is thus divided into 100 units. In other words, T scale ranges from 0 to 100, with a mean of 50. Its unit of measurement is T, which is 0.1 of standard deviation (σ), and standard deviation here has a value of 10.

How to convert raw scores into T scores

The formula used for converting raw scores into T scores runs as follows :

$$T = 10z + 50$$

It means that one has to compute the value of z for knowing the value of T and as we know the value of z may be computed by the use of the formula $z = (X - M)/\sigma$. Hence the procedure for computing T scores from a known raw score X may run as under.

1. First compute the mean (M) and standard deviation (σ) of the distribution.
2. Then compute the value of z by making use of the formula $z = (X - M)/\sigma$
3. Then calculate the value of T by making use of the formula $T = 10z + 50$

Let us know the use of the formula and application of T scores with the help of an example.

Example : In an examination, two students, Sunita and Preeti, obtained the scores given below in different papers. Find out which one of them performed better by computing the respective T scores.

Raw scores of two students in three papers along with their Mean and Standard deviation

Papers	Raw Scores of Sunita	Scores of Preeti	M	SD or σ
Physics	70	62	65	10
Mathematics	80	75	70	5
Chemistry	42	55	45	6

Solution.

Step 1 : Computation of T scores obtained by Sunita and Preeti in different subjects

(i) T scores in the subject Physics

$$T \text{ score of Sunita} = 10z + 50$$

$$\text{The value of } z = (X - M)/\sigma = (70 - 65)/10 = 5/10$$

$$T \text{ score of Sunita in Physics} = 10(5/10) + 50 = 5 + 50 = 55$$

$$T \text{ score of Preeti} = 10z + 50$$

$$\text{The value of } z = (X - M)/\sigma = (62 - 65)/10 = -3/10$$

$$T \text{ score of Preeti in Physics} = 10(-3/10) + 50 = -3 + 50 = 47$$

(ii) T scores in the subject Mathematics

$$T \text{ score of Sunita} = 10z + 50$$

$$\text{The value of } z = (X - M)/\sigma = (80 - 70)/5 = 10/5$$

$$T \text{ score of Sunita in Mathematics} = 10(10/5) + 50 = 20 + 50 = 70$$

$$T \text{ score of Preeti} = 10z + 50$$

$$\text{The value of } z = (X - M)/\sigma = (75 - 70)/5 = 5/5$$

$$T \text{ score of Preeti in Mathematics} = 10(5/5) + 50 = 10 + 50 = 60$$

(iii) T scores in the subject Chemistry

$$T \text{ score of Sunita} = 10z + 50$$

$$\text{The value of } z = (X - M)/\sigma = (42 - 45)/6 = -3/6 = -1/2$$

$$T \text{ score of Sunita in Chemistry} = 10(-1/2) + 50 = -5 + 50 = 45$$

$$T \text{ score of Preeti} = 10z + 50$$

$$\text{The value of } z = (X - M)/\sigma = (55 - 45)/6 = 10/6$$

$$T \text{ score of Preeti in Chemistry} = 10(10/6) + 50 = 16.66 + 50 = 66.66$$

Step 2 : Add the T scores of the three subjects of both the students

$$\text{Total scores of Sunita} = 55 + 70 + 45 = 170$$

$$\text{Total scores of Preeti} = 47 + 60 + 66.66 = 173.66$$

Conclusion : The overall performance of Preeti is better than that of Sunita.

Stanine Scores

Stanine scale is a nine-point scale. This scale provides a single-digit system of scores with a mean of 5 and standard deviation of approximately 2. The term stanine stands for the contraction of standard nine, indicating

that this nine-point scale is related with the conversion of raw scores into some standard scores. Stanine scale was first used during World War II by the United States Army Air Force Aviation Psychology Program for converting the test scores into standard nine categories.

For transforming raw scores into stanine scores, the stanine scale is so arranged as to have its mean as 5.0 (exactly at the middle), with 1 and 9 as the lowest and the higher point on the scale. In this way, the stanine scale ranges from 1 to 9 having 9 units providing 9 score categories or groups for a given distribution of original raw scores.

As a general rule, for grouping, the normality of the distribution needs to be assumed. A standardised sample of an achievement or psychological tests. the distribution of subjects' scores is often normal or near normal. Hence, the test developer may remain assured of the normality of the distribution of the raw scores. Now for grouping or distributing the raw scores earned by the subjects on his test, he may divide the base line of the normal curve into 9 equal divisions in terms of standard deviation units. The percentage of the area covered by each category ranging from 1 to 9 on the stanine scale can now be seen in Table 17. 2.

TABLE 17.2. The Stanine scale system

Stanine scale	z or σ scores limits	Percentage area of the area falling in this limit	Percentage of the area (rounded)	Cumulative percentage
9	1.75 σ to 3 σ	3.88	4	100
8	1.25 σ to 1.75 σ	6.6	7	96
7	0.75 σ to 1.25 σ	12.1	12	89
6	0.25 σ to 0.75 σ	17.4	17	77
5	-0.25 σ to 0.25 σ	19.8	20	60
4	-0.75 σ to -0.25 σ	17.4	17	40
3	-1.25 σ to -0.75 σ	12.1	12	23
2	-1.75 σ to -1.25 σ	6.6	7	11
1	-3 to -1.75 σ	3.88	4	4

The diagrammatic presentation of stanine scale, showing percentage of cases to each unit of 9-point scale and corresponding σ scores limits on the base line of the curve, may be illustrated as in Figure 17.6.

Steps for converting raw scores into stanine scores

Step 1 : Arrange the set of raw scores in the ascending order, i.e. from the lowest to the highest.

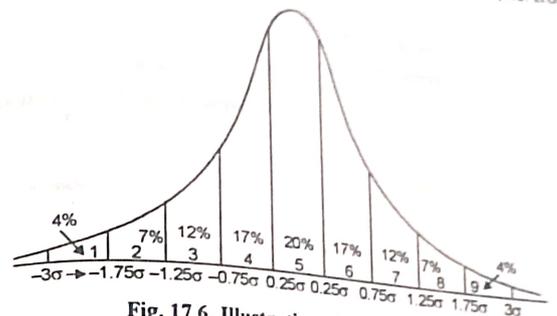


Fig. 17.6. Illustration of relationship of Stanines with the σ scores and area percent.

Step 2 : For the lowest 4 per cent, assign a score of 1 and for the next lowest 7 per cent, assign a score of 2. Similarly, for the next in the ascending order like 12 per cent and 17 per cent, assign the scores 3 and 4 respectively. Continue this process until you assign a stanine score of 9 for the top 4 per cent.

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. Discuss in detail the concept of normal distribution.
2. What is a normal curve? Throw light on its main characteristics and properties.
3. What are standard scores? Why is it necessary to convert raw scores into one or the other types of standard scores? Explain with examples.
4. What are z scores or sigma scores? Discuss the procedure of converting raw scores into z scores or σ scores with example.
5. Discuss the application and use of z scores along with their merits and limitations.
6. What are T scores? Discuss the procedure of converting raw scores into T scores with example.

7. What are stanine scores? How raw scores can be converted into stanine scores? Explain.

B. SHORT ANSWER TYPES QUESTIONS

1. What in normal distribution.
2. What in a normal curve.
3. Provide any three characteristics of a normal curve.
4. What are standard scores/z scores or sigma scores/T scores/stanine scores.
5. Provide the formula for computing z scores/T scores.
6. Outline the steps for converting raw scores into stanine scores.

Correlation

CHAPTER OUTLINE

- Introduction
- Linear Correlation
- Coefficient of Correlation
- Computation of Coefficient of Correlation
 - Rank Difference Method
 - Product Moment Method
- Study Questions

Introduction

In Education as well as Psychology there are times when it is needed to know whether there exists any relationship between the different abilities of the individual or they are independent of each other. Consequently, there are numerous questions like the following which have to be answered:

- (i) Does scholastic achievement depend upon the general intelligence of a child?
- (ii) Is it true that the height of the children increases with the increase in their age?
- (iii) Is there any relationship between the size of the skull and general intelligence of the individuals?
- (iv) Is it true that Dull children tend to be more neurotic than the bright children?

The questions and problems like the above in which there is a need of finding out the relationship between two variables (Age and height, Intelligence and Achievement etc.) can be tackled properly by the method of correlation.

There are many types of correlation like Linear, Curvilinear, Biserial, Partial or Multiple correlation that are computed in statistics. As we, in this text, aim to have an elementary knowledge of the statistical methods we will take only the Linear correlation in the following pages.

Linear Correlation

This is the simplest kind of correlation to be found between the two sets of scores or variables. Actually, when the relationship between two sets of scores or variables can be represented graphically by a straight line, it is known as Linear Correlation. Such type of correlation clearly reveals how the change in one variable is accompanied by a change in the other or to what extent increase or decrease in one is accompanied by the increase or decrease in other.

The correlation between two sets of measures of variables can be positive or negative. It is said to be positive when an increase (or decrease) in one corresponds to an increase (or decrease) in the other. It is negative when increase corresponds to decrease and decrease to increase. There is also possibility of third type of correlation *i.e.* zero correlation between the two sets of measures or variables if there exists no relationship between them.

Coefficient of Correlation

For expressing the degree of relationship quantitatively between two sets of measures of variables we usually take the help of an index that is known as coefficient of correlation. It is a kind of ratio which expresses the extent to which changes in one variable are accompanied changes in the other variable. It involves no units and varies from -1 (indicating perfect negative correlation) to $+1$ (indicating perfect positive correlation). In case the coefficient of correlation is zero, it indicates zero correlation between two set of measures.

Computation of Coefficient of Correlation

There are two different methods of computing coefficient of correlation (linear). These are :

(A) Rank Difference Method (B) Product Moment Method.

Below we discuss them one by one.

(A) Rank difference Method of computing coefficient of correlation

In computing coefficient of correlation between two sets of scores achieved by the individuals, with the help of this method we require ranks *i.e.* positions of merits of these individuals in the possession of certain characteristics. The coefficient of correlation computed by this method, as it considers only the ranks of the individuals in the characteristics A and B is known as Rank correlation co-efficient and is designated by Greek letter (ρ). Sometimes it is also known as Spearman's coefficient of correlation after the name of its inventor.

Correlation

In case where we do not have scores and have to work with data in which differences between the individuals in the possession of certain characteristics can be expressed only by ranks Rank correlation coefficient is the only correlation coefficient that can be computed. But this does not mean that it cannot be computed from the usual data given in scores. In case the data contain scores of individuals, we can compute by converting them into ranks. For example if the marks of a group of 5 students are given as 17, 25, 9, 35, 18 we will rank them as 4, 2, 5, 1 and 3. We determine the rank of position of the individuals in both the given sets of scores. These ranks are then subjected to further calculation for the determination of the coefficient of correlation.

How it is done can be understood properly through the following illustration :

Example 1

Individual	Marks in the Subject of History X	Marks in the Subject of Civics Y	Rank in History R_1	Rank in Civics R_2	Difference in Rank irrespective of signs -ive of $ d $ $ R_1 - R_2 $	Difference squared d^2
A	80	82	2	3	1	1
B	45	86	11	2	9	81
C	55	50	10	10	0	0
D	56	48	9	11	2	4
E	58	60	8	9	1	12
F	60	62	7	8	1	1
G	65	64	6	7	1	1
H	68	65	5	6	1	1
I	70	70	4	5	1	1
J	75	74	3	4	1	1
K	85	90	1	1	0	0
N = 11					$\sum d^2 = 92$	

$$\text{Formula } \rho = 1 - \frac{6 \sum d^2}{N(N^2 - 1)} = 1 - \frac{6 \times 92}{11(11^2 - 1)} = 1 - \frac{6 \times 92}{11 \times 120}$$

$$= 1 - \frac{23}{55} = 1 - .42 = .58$$

Example 2

Individuals	Scores in Test X	Scores in Test Y	Rank in X_1 , R_1	Rank in X_2 , R_2	$ R_1 - R_2 = d $	d^2
A	12	21	8	6	2	4
B	15	25	6.5	3.5	3	9
C	24	35	2	2	0	0
D	20	24	4	5	1	1
E	8	16	10	9	1	1
F	15	18	6.5	7	0.5	0.25
G	20	25	4	3.5	0.5	0.25
H	20	16	4	9	5	25
I	11	16	9	9	0	0
J	26	38	1	1	0	0

$N = 10$ $\sum d^2 = 40.5$

$$\begin{aligned} \text{Now } \rho &= 1 - \frac{6\sum d^2}{N(N^2 - 1)} \\ &= 1 - \frac{6 \times 40.5}{10(10^2 - 1)} = 1 - \frac{6 \times 40.5}{10 \times 99} \\ &= 1 - \frac{8.1}{33} \\ &= 1 - .245 \\ &= 0.755. \end{aligned}$$

Steps for the calculation of ρ

1. First of all it is required to assign position of merit or rank to each individual on either test. These ranks are put under column 3 (designated as R_1) and 4 (designated as R_2), respectively. The task of assigning ranks in the cases like example 1st is not difficult. But in the cases, like example 2nd, where two or more individuals are found to achieve same score, some difficulty arises. In the above example, in the first test X, B and F are two individuals who have the same score i.e. 15. Therefore, score 15 occupies 6th position in order of merit. But now the question arises which one of the two individuals B and F should be ranked as 6th or 7th. In order to overcome

Correlation

this difficulty we equally share the rank 5th and 7th between them and thus rank each one of them as 6.5

Similarly, if there are three persons who have the same score and share the same ranks, we take the average of the ranks claimed by these persons. For example, we can take the score 20 in the 2nd example which is shared by three individuals D, G and H. It is ranked third in the whole series and therefore the ranks 3, 4 and 5 are shared equally by D, G and H, and hence we attribute rank 4 to each of them.

2. After writing down the allotted ranks to all the individuals on either of the two tests, the differences in these ranks are calculated. In doing so we do not consider the algebraic signs +ve or -ve of the difference. This difference is written under column 5th (designated as $|d|$).

3. In the next column (designated as d^2) we square up the Rank difference or the values of d written in the column 5th.

4. Now we calculate the total of all the values of d^2 and this sum is designated as $\sum d^2$.

5. Now the value of ρ is calculated by the formula $\rho = 1 - \frac{6\sum d^2}{N(N^2 - 1)}$

where d^2 stands for the sum of the squares of differences between the ranks of the scores on two different tests and N for the number of individuals whose scores are under consideration for computing.

(B) Product Moment method of computing coefficient of correlation. This method is also known as Pearson Product Moment method in the honour of the English statesman Karl Pearson who is said to be the inventor of this method. The coefficient of correlation computed by this method is known as Product Moment coefficient of correlation and symbolically represented by ' r '.

(a) The calculation of ' r ' from ungrouped data. The basic formula for the computation of ' r ' for the ungrouped data by this method is

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \cdot \sum y^2}}$$

where x and y represent the deviation of scores in the tests X and Y from the means of each distribution.

The procedure of calculating r by this formula can be understood by the following illustration:

Individuals	Scores in Text X	Scores in Text Y	x (X-Mx)	y (Y-My)	Σxy	x^2	y^2
A	15	60	-10	10	-100	100	100
B	25	70	0	20	0	0	400
C	20	40	-5	-10	50	25	100
D	30	50	5	0	0	25	0
E	35	30	-10	-20	-200	100	400
					Σxy = -250	Σx^2 = 250	Σy^2 = 1000

Mean of series X (Mx) = 25

Mean of series Y (My) = 50

$$\text{Formula } r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \cdot \Sigma y^2}} = \frac{-250}{\sqrt{250 \times 1000}} = \frac{-250}{\sqrt{250000}}$$

$$r = \frac{-25}{500} = -\frac{1}{2} = -0.5$$

(b) Computation of r directly from raw scores when deviations are taken from zero (without calculating deviations from the means). Here we apply the formula.

$$r = \frac{N \Sigma XY - \Sigma X \cdot \Sigma Y}{\sqrt{[N \Sigma X^2 - (\Sigma X)^2][N \Sigma Y^2 - (\Sigma Y)^2]}}$$

The use of this formula can be understood through the following example:

Subject	Scores in 1st Test (X)	Scores in 2nd Test (Y)	XY	X^2	Y^2
A	5	12	60	25	144
B	3	15	45	9	225
C	2	11	22	4	121
D	8	10	80	64	100
E	6	18	108	36	324
N=5	$\Sigma X=24$	$\Sigma Y=66$	$\Sigma XY=315$	$\Sigma X^2=138$	$\Sigma Y^2=914$

$$r = \frac{5 \times 315 - 24 \times 66}{\sqrt{[5 \times 138 - 576][5 \times 914 - 66 \times 66]}}$$

$$= \frac{1575 - 1650}{\sqrt{[690 - 576][4570 - 4356]}}$$

$$= \frac{-75}{\sqrt{24396}} = \frac{-75}{156.2} = -0.48$$

Ans. $r = -0.48$

STUDY QUESTIONS

A. ESSAY TYPE QUESTIONS

1. What is correlation in statistics? Discuss its types? How is it useful in the field of education?
2. What is coefficient of correlation? How can it be computed by utilizing Rank difference method?
3. What is coefficient of correlation? How can it be computed by utilizing product moment method?
4. Find the correlation between the following two sets of scores using product moment method.

Subject	A	B	C	D	E	F	G	H
Test X	15	18	22	17	19	20	16	21
Test Y	40	42	50	45	43	46	41	41

Ans. $r = .65$

5. Find the correlation between the following two sets of raw scores without computing deviation from the mean.

Individual	A	B	C	D	E	F	G	H	I	J
	13	12	10	8	7	6	6	4	3	1
	7	11	3	7	2	12	6	2	9	6

Ans. $r = 0.14$

6. Compute the coefficient of correlation between the following two series of test scores by Rank difference method.

ASSESSMENT FOR LEARNING

(a) Pupils	Text X	Text Y	(b) Pupils	Text X	Text Y
A	40	42	A	12	16
B	36	35	B	26	25
C	27	28	C	21	15
D	18	27	D	23	21
E	13	15	E	25	22
F	48	48	F	15	21
G	43	50	G	18	27
H	25	27	H	22	30
I	29	32	I	18	28
J	17	21	J	19	23

Ans. 0.985

Ans. 0.188

7. Find the correlation coefficient between the following set of scores product moment method.

Subject	a	b	c	d	e	f	g	h	i	j
Test x	13	12	10	10	8	6	6	5	3	2
Test y	11	14	11	7	9	11	3	7	6	1

Ans. 0.76

8. Find the Rank correlation coefficient from the following data :

Individuals	A	B	C	D	E	F	G	H
Marks in Hindi	30	40	50	20	10	45	22	18
Marks in English	55	75	60	12	11	38	25	15

Ans. 0.86

B. SHORT ANSWER TYPE QUESTIONS

1. What is correlation as a statistical measure ?
2. Why do we compute correlation as a statistics in education ?
3. Name the different types of correlation computed in the field of education.
4. What is coefficient of correlation ?
5. What is rank difference method of computing coefficient of correlation ?
6. Provide a formula for computing coefficient of correlation by rank difference method.
7. What is product moment method of computing coefficient of correlation ?
8. Provide a formula for computing coefficient of correlation by product moment method in the case of ungrouped data.
9. Provide the possible highest and lowest value of coefficient of correlation

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