
UNIT 1 CURRICULUM OF MATHEMATICS AT THE PRIMARY STAGE

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1.1 INTRODUCTION

In this era of science and technology, a strong base of mathematics is considered to be an absolute necessity for all. Its knowledge in various forms from elementary to advanced level is required in every walk of life, whether it is home, business, industry, government, computers or decision-making. It has been recognized all over the world that every citizen needs to be equipped with certain basic mathematical knowledge and skills. Therefore, mathematics has become a part of universal education and has been made a compulsory subject of study from class I to X.

Mathematics though it occupies a significant place in our school curriculum, its learning is a problem for a large number of children even at class I stage. The problem is more acute from class III onwards. The number of students failing in mathematics is increasing day by day. Intensive efforts are being made at different levels to overcome this problem, but we have been successful only to a little extent. It seems that mathematics taught in schools today results in learning rules and procedures without developing the conceptual understanding and the reasoning power amongst children. The problem is because of the ignorance of teachers about the needs and importance of teaching mathematics at the primary stage. In order to be able to teach mathematics in an effective manner, you should have a clear understanding of the curriculum of mathematics. In this unit, you will study about the curriculum of mathematics at the primary stage.

1.2 OBJECTIVES

After studying this unit, you should be able to:

- list the functional, disciplinary and the cultural importance of learning mathematics;
- know the objectives of teaching mathematics at the primary stage;
- comprehend the socio-cultural, political and economic considerations influencing the curriculum;
- highlight the pedagogical and mathematical considerations for the selection of content;
- organize the curriculum of mathematics;
- explain the concepts related to the MLLs;
- apply continuous and comprehensive evaluation in your class; and
- make the mathematics teaching-learning competency based.

1.3 IMPORTANCE OF LEARNING MATHEMATICS

It is impossible to think of an activity without the use of mathematics, whether it is any un- skilled work like digging of earth, loading and unloading of goods, grazing of animals, labour work in factory or any skilled work like measurement, mechanical work, calculation etc. It is often only by the use of the measurement function of mathematics that one is able to describe the physical objects and events. No economic activity can be performed without mathematics. Mathematics is, therefore, necessarily required to be learnt by all. The functional, disciplinary and cultural aspects of learning mathematics are discussed in the following section.

1.3.1 Functional Aspects

A peep into the history of mathematics tells us that the main motivation for the learning of mathematics came from its functional utility. While geometry was necessitated by problems of land surveying; arithmetic and algebra found their uses in commerce, problems of measurement and mensuration. Some of the aspects of geometry like symmetry are manifest in architecture, sculpturing and fine arts. The observation of natural phenomena like the appearance of the pole star in fixed position in the sky, the cyclic occurrence of celestial phenomena and the associated mathematical processes helped mankind to improve the techniques in the field of astronomy. The optimal use of farms and better yields are due to the influence of mathematics. Even, the planning of various systems of transportation and communication are based on the knowledge of mathematics. Many scientific discoveries are the result of mathematics. Some of the competence reflecting the functional aspect of mathematics can be described as under:

1. Computation with numbers, fractions and decimals involving addition, subtraction, multiplication and division
2. Percents/Ratio
3. Estimation/Rounding numbers
4. Reading tables/Graphs
5. Measurement and use of devices
6. Statistics

7. Spatial relationships — construction in geometry
8. Pythagorean relation
9. Algebraic symbolism
10. Formulae used in every day life

1.3.2 Disciplinary Aspects

Mathematics as a discipline has many values, which are associated with its study. Mathematics disciplines the mind to function in a particular manner. Certain desirable attitudes, interests and appreciations have to be cultivated in children. Objectivity, rational outlook, critical thinking abilities, scientific temper, recognition and appreciation of aesthetics are the traits cultivated amongst young learners by teaching of mathematics. Recognition of patterns, rhythms and periodicity in the occurrence of natural events have helped human beings to plan their life style and solve the day to day problems of life.

However, the disciplinary aspects of mathematics teaching are developed over a long period of time and needs sustained efforts of the teachers right from the primary stage of education.

1.3.3 Cultural Aspects

Study of an individual's behaviour without a study of the world in which he/she lives in, is incomplete. For this, one has to know about the civilization as well as cultural heritage of the concerned society. Mathematics is associated closely with the cultural heritage of each country. Our country has a mathematical heritage which we are proud of. The numerals, decimal system of numeration and zero which the whole world is using today was the gift of ancient Indian mathematicians. The glorious names of some famous Indian mathematicians are Sridhara, Bhaskaracharya, Varah Mihira, Aryabhata, Brahmagupta and Ramanujan. Young minds need to be inspired by the works of these great mathematicians. Awareness has to be created in the learners at primary stage itself regarding the glorious mathematical heritage of our country.

1.4 OBJECTIVES OF TEACHING MATHEMATICS AT THE PRIMARY STAGE

One of the major objectives of teaching primary mathematics is to enable children to solve speedily and accurately the numerical and spatical problems which they encounter at home, in the school and in the community. It should help children develop understanding of key mathematical concepts through appropriate experiences with the physical world and the immediate environment. So the mathematics curriculum at the primary stage should be directed to achieve the following objectives:

- i) Ability to perform computations with speed and accuracy;
- ii) Ability to translate a verbal statement (a) in mathematical form using appropriate symbols, and (b) diagrammatically;
- iii) Ability to make reasonably good approximations and estimate measurements;
- iv) Ability to apply mathematical concepts and skills to solve simple problems of day to day life;
- v) Ability to think logically; and
- vi) Ability to recognize order and pattern.

In addition to the above objectives of teaching mathematics at the primary stage, the following objectives related to social aspects are also catered to at the primary stage:

- i) Ability to appreciate the contribution of mathematics towards the advancement of technology and other fields of human endeavour;
- ii) Knowledge of social significance of institutions like banking, insurance, taxation etc.;
- iii) Ability to use the measurement skills in the instruments of precision; and
- iv) Ability to become an intelligent consumer, investor and problem solver.

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answer with the one given at the end of this unit.

1. List any five functional aspects of learning mathematics.

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2. Which of the three aspects of learning mathematics (a) functional aspect (b) disciplinary aspect and (c) cultural aspect, reflect the inculcation of scientific temper?

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3. List the six major objectives of teaching mathematics at the primary stage.

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1.5 CURRICULUM OF MATHEMATICS AT THE PRIMARY STAGE

For maintaining the relevance of the mathematics curriculum to the societal and personal needs of the learners, it should continuously undergo change in the light of changing national goals and priorities. The present day criticism of the

mathematics curriculum is that neither the personal needs of the learners nor the societal needs are being taken care of. To overcome this problem, the Minimum Levels of Learning in Mathematics have been specified for the Primary Stage. In the following section, the curriculum is being discussed in terms of the factors influencing it, its organization and the MLLs in Mathematics.

1.5.1 Factors Influencing the Curriculum of Mathematics

Education is a powerful instrument of human resource development. It should help in the process of desired social transformation. The content and the process of education should be carefully planned leading to the desired change in learner's behaviour in the context of socio-cultural, political and economic considerations and the pedagogical considerations.

1.5.1.1 Socio-Cultural, Political and Economic Considerations

For the selection of mathematical content at the primary stage, the following socio-cultural, political and economic considerations are taken into account.

i) Equality of Education and Opportunity

To promote equality of educational opportunity, not only the availability of schooling facility but also the conditions for success are to be ascertained. For this the curriculum will have to be so designed that children belonging to different social, economic and cultural background have equal chances of success. The curriculum has to specifically take care of first generation learners, which is the predominant feature of North-Eastern States. The provision for remedial teaching and the required teaching-learning material is to be made in the mathematics curriculum.

ii) Preservation of Cultural Heritage

For strengthening the unity and integrity of the nation it is essential that the cultural heritage, traditions and history of various ethnic groups are understood and appreciated. The curriculum should not only preserve the cultural heritage of our country but it should also help the younger generation to adapt the new practices appropriate for a modern society.

iii) Character Building and Inculcation of Values

The mathematics curriculum may be so designed that it inculcates truthfulness, straight forwardness and other scientific values. The habit of continuous and hard work may also be inculcated.

iv) Future-Oriented Education

The vast expansions of knowledge in all fields, including science and technology and the changing socio-economic conditions of the society necessitates modernisation of curriculum. One of the goals of education being the preparation of the pupil for his/her future life, the curriculum should be such that the pupil will adequately respond to the challenge posed by advancement of science and technology and is able to adjust to the changing socio-economic conditions.

1.5.1.2 Pedagogical Considerations

Mathematics curriculum in order to be realistic, relevant and meaningful has to be in tune with the pedagogical goals and the nature of the mathematical content. It should be based on systematic research about the nature of the learner, the learning process and presentation of mathematics curriculum to the learners. The following issues are particularly relevant for planning of the mathematics curriculum:

- i) The developmental needs of the pupil, his/her intellectual development and capability of learning at different stages;
- ii) The place of mathematics in changing society;
- iii) More significant interpretations in a changed context of mathematical knowledge;
- iv) New knowledge of mathematics for adaptation at the primary stage;
- v) Criteria for planning a program in mathematics that will guarantee maximum benefits to slow and gifted children;
- vi) Potential interest and challenges in mathematics;
- vii) Avoidance of frustrations by eliminating unattainable mathematical concepts from the curriculum;
- viii) Adaptation or change of conventional topics;
- ix) Use of new topics for enrichment of traditional ones; and
- x) Use of continuous and comprehensive evaluation and the provision of remedial teaching.

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answer with the one given at the end of this unit.

4. Why do we require a change in the mathematics curriculum?

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5. Explain the concept 'equality of education and opportunity'

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6. Why should we have future-oriented education?

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1.5.2 Organizing the Curriculum of Mathematics

The curriculum-makers are faced with the problem of organizing the selected content of the mathematics program. Mathematics itself has an inbuilt and coherent logic that determines the sequential order of the subject matter to be taught. This is especially true of number and number operations. Topics dealing with the

measurement and its applications in solving daily life problems allow for a much wider flexibility of organization of content. The mathematical fact of the curriculum can be presented in the form of broad outlines after logical analysis of its contents. The grade placement of the content from class I to V can be determined through the capacity of the learners and the societal demands.

1.5.2.1 Selection of the Subject Matter

There are four basic procedures that are used for the selection of the subject matter:

1. Judgmental procedure
2. Analytical procedure
3. Experimental procedure
4. Consensual procedure

Judgmental Procedure

While following judgmental procedure, we are faced with a number of questions, such as: (i) What are the goals and objectives of teaching mathematics? (ii) To what extent these goals and objectives are being achieved in our schools? (iii) What subject matter and experiences are most likely to lead to the attainment of these objectives under the existing conditions?

So the first step is the extensive discussion in the setting up of these goals and objectives. These will be general for the school curriculum as a whole and specific for the mathematics curriculum. Based on these goals and objectives, subject matter and experiences are decided on by subject experts and teachers.

Analytical Procedure

This procedure involves the study of the activities of people when they are working in a vocation. Here the activities they are carrying out are being analyzed in order to find out the mathematics content being used. Analytical procedures are extensively used to study the utility of mathematics in daily life situations.

Experimental Procedure

When we are developing a mathematics curriculum, a number of questions arise, such as: (i) Can young children learn mathematics? (ii) Which of the mathematics content should be taught at what level? (iii) To what extent should a particular content be dealt with for children of specified age group? (iv) Should we have different content for the fast learners and the slow learners? and so on.

The answers to all these questions are sought by a systematic try-out of curriculum content under prescribed conditions. Here a number of factors are controlled to minimize the try-out error due to group or personal biases. A specific experimental try-out may respond to a specified question only and may not be true under a different situation. So the larger scale try-out are required for the generalizations of the findings. The curriculum framers are required to take into consideration all such studies carried out till date for better effectiveness of the curriculum.

Consensual Procedure

The consensual procedure involves methods of securing information about the opinion of the people about the mathematics curriculum. Here we usually involve the parents and the teachers. While interacting with them, the problems and issues involved are discussed in detail so that the influence of vested interests, tradition and prejudices are minimized.

For the finalization of a curriculum, more than one approaches are followed.

1.5.2.2 Gradation of Curriculum Content

After the subject matter is selected for the mathematics curriculum, there comes the question of the gradation of curriculum content. There are several ways in which the subject matter may be assigned to different grades. One is the placement of content according to the interest and the maturity level of the learners. The second is the placement of content to particular grade level and then try to bring the children upto that level. The third approach is even to change the goals and objectives for adaptation of content and activities in terms of needs and abilities of individual children. Rather than using these approaches separately, they are used in conjunction for grade placement of subject matter. Otherwise there is a possibility of neglecting adequate content for the sake of needs and development of children or stress on subject matter and neglecting the need of the child.

1.5.3 Minimum Levels of Learning in Mathematics for the Primary Stage

The focus of Universalisation of Primary Education (UPE) has been on (a) Universal Access—availability of Primary School / NFE Centre to all the learners within a walking distance of 1 Km. (b) Universal Enrollment—bringing all the children in the age group 6 -11 years in the school network, and (c) Universal Retention—retaining all the children in the school network for full duration of 5 years. A great success has been achieved with regard to the first two aspects. However the Drop-out Rate—children leaving the school before completing 5 years of schooling, is still alarming. In NPE, 1986, another dimension that has been added to the UPE is Universal Achievement—all the children attaining the goals set for Primary Education. In other words, the focus is on improvement of quality of education at the primary stage. As at present, there is wide variation in the quality of education in different parts of the country. In order to bring in uniformity in the existing standards of education, emphasis has been laid on the identification of Minimum Levels of Learning (MLLs) for each stage of school education. A committee under the chairmanship of Prof. R.H. Dave was set up by MHRD, Govt. of India in 1990 for the identification of MLLs at the Primary Stage. This committee identified the minimum levels of learning in three major areas, namely language, mathematics and environmental studies. While identifying the MLLs, the committee kept in view the research findings as well as the feasibility aspects. The work of this committee has been reported in the form of a MLL document.

In the MLL Document, key mathematical concepts for each of the five classes of primary stage of education have been classified under the following five areas of mathematical competencies:

1. Understanding of whole numbers and numerals
2. Ability to add, subtract, multiply and divide whole numbers
3. Ability to use and solve simple problems of daily life relating to units of money, length, weight, capacity, area and time
4. Ability to use fractions, decimals and percentage, and
5. Understanding of geometrical shapes and spatial relationships.

1.5.3.1 Curriculum in Terms of Competencies

A curriculum may be specified in a variety of ways. It can be stated as mathematics content presented in sequential order for each grade. It may also be stated as a learning outcome expected to be attained by learners at the end of the primary stage of education. Further, it may again be stated as the expected learning outcomes or competencies to be achieved by the learners by the end of a particular class. For specifying the 'Minimum Levels of Learning' the curriculum has been stated in terms of competencies to be attained by the learners at the end of a

particular year. So the term 'competency' refers to a learner's capability of successfully completing a task for which the instructions have been designed.

1.5.3.2 Mastery Learning Approach

As you know, the MLLs have been stated in terms of competencies. It means that these competencies are to be attained by the learners for whom the competencies have been specified. Now the question is when will we say that a specified competency has been attained by the learners? Is it when the learners give pass performance related to that competency? Or should it be at a higher level? This question can be answered if we analyze the purpose of introducing MLLs at the primary stage. The MLLs have been introduced in order to improve the quality of education at the primary stage. The quality will be expected only when all the learners in classes I to V are able to master all the competencies listed for them i.e. the learner is able to respond to almost all the questions asked from them. In short, a particular competency of a class will be considered to be mastered, if at least 80% of the learners of that class are able to reach 80% level. Please remember that the remaining 20% of the learners are also to be brought to 80% level subsequently.

1.5.3.3 Continuous and Comprehensive Evaluation

You know that the focus of MLL approach is at the mastery of the listed competencies. In order to assess whether the pupil has mastered the competency or not, it is essential to evaluate his/her performances on regular basis. The learner will be able to acquire a particular competency only if he/she has mastered the earlier competencies. So the teaching of a new competency is dependent on the mastery of the existing competency by all or almost all learners. It means that the evaluation has to be on continuous basis. In real practice it has to be made an integral part of the teaching-learning process.

At present the evaluation is done by asking a limited number of questions covering the entire curriculum or a large part of it. But the focus of MLL approach is to test a limited portion of curriculum by asking a variety of questions. The purpose is to evaluate the competencies thoroughly. Not only that, besides the cognitive areas of learning mathematics, non-cognitive areas are also to be tested, which means the evaluation has to be continuous and comprehensive.

Competency based continuous and comprehensive evaluation is being discussed in detail in a subsequent unit.

1.6 COMPETENCY BASED TEACHING-LEARNING IN MATHEMATICS

So far the focus of the teaching-learning process in mathematics used to be the content to be taught to the learners. For planning the lesson to be taught in the classroom, the teacher lists the objectives to be attained by the teaching of the lesson. Now the focus of teaching-learning process has shifted to the mastery of a specified competency. Here we focus on the specified competency and think of the content which will be suitable for the attainment of that competency. Not only that, the teacher will have to ensure that the learners have mastered the earlier competency on whose attainment the present competency is dependent. If the learners are lacking in that regard, then remedial teaching will have to be carried out, so that the learning of present competency is not hampered.

For competency based teaching-learning the child centered approach is to be followed as each and every child is to be brought to the mastery level. Further, as the learners are of the age group of 6 -11, activity based approach is a must. However, the activities to be chosen for development of the competency should

be interesting and simple. Moreover, if possible, separate activities should be undertaken by fast learners, average learners and slow learners. It will help them learn at their own pace.

As discussed earlier, evaluation is to be considered as an integral part of the teaching-learning process, that also in the form of continuous and comprehensive evaluation. If the learners are not able to learn as desired, then the teaching-learning process may have to be improved. An important aspect of the teaching-learning process is the availability of good learning material to the learners. For making teaching-learning more effective, good competency based text books, work books and teachers' handbooks are required. But the effectiveness of these material depends on their use by the teachers and the learners. For this, whenever competency based teaching-learning material is available, teachers will have to be trained for their effective use.

Mathematics is a subject which manipulates elements, usually abstract in nature. As a result, the teaching and learning of mathematics has become quite difficult. However, to overcome this problem, experiential approach in teaching-learning of mathematics is suggested at the primary stage. For this, concrete/semi-concrete materials, may be used for the development of mathematical concepts and skills, leading to the mastery of the competencies.

1.7 LET US SUM UP

Mathematics is a compulsory subject upto the secondary level of education. We have tremendous utility of mathematics in day-to-day life as well as in other disciplines. Besides the functional utility of mathematics, it also has discipline-based and cultural importance, which need to be highlighted in the school curriculum. The objectives of teaching mathematics may be summarized as ability to (a) perform computations with speed and accuracy, (b) translate verbal statements into mathematical form or diagrammatically (c) make good approximations and estimate measurements (d) apply mathematical concepts for problem solving (e) think logically, and (t) recognize order and pattern.

The mathematics curriculum needs constant change in the light of the personal needs of the learners and the societal needs. The major socio-cultural, political and economic considerations for mathematics curriculum are (a) equality of educational opportunity (b) preservation of cultural heritage (c) inculcation of scientific values, and (d) future-oriented education. Nature of mathematical content and the pedagogical considerations are also taken into account for designing the mathematics curriculum.

For the selection of the subject matter, we may use one or more of the following procedures, namely, judgmental, analytical, experimental and consensual. For gradation of selected content, a number of approaches are used in conjunction.

Minimum levels of learning at the primary stage have been specified in order to improve the quality of learning amongst all the learners. It is specified in terms of competencies which the learner is expected to master after undergoing the teaching-learning process. These competencies are to be mastered by almost all the children. The focus of MLL approach is on continuous and comprehensive evaluation. Further the focus of teaching-learning process has shifted from teaching to learning. If a learner is not able to master a competency, remedial teaching is to be provided to him/her

The focus in MLL approach is also on a child-centered activity-based approach. For this, competency-based teaching-learning material based on the need of the learners is required. The teachers have to be trained for the use of competency based teaching-learning material

1.8 UNIT-END EXERCISES

1. In addition to the functional utility of learning mathematics at the primary stage describe the other advantages of learning mathematics.
2. Describe the pedagogical considerations to be taken into account for making mathematics curriculum realistic, relevant and meaningful.
3. Why do we require the specification of MLLs in mathematics?
4. Describe the concept of mastery learning approach.
5. When will you say an evaluation to be continuous and comprehensive?
6. What type of teaching-learning material is required for the competency based teaching-learning process?

ANSWERS TO CHECK YOUR PROGRESS

1. Out of given points, any five of the following can be stated as answer.
 - i) Computation with numbers, fractions and decimals
 - ii) Percents / Ratio
 - iii) Estimation / Rounding numbers
 - iv) Reading tables / graphs
 - v) Measurement
 - vi) Statistics
 - vii) Constructions in geometry
 - viii) Pythagorean relation
 - ix) Algebraic symbolism
 - x) Formulae used in every day life
2. Disciplinary Aspect.
3.
 - i) Ability to perform computations with speed and accuracy
 - ii) Ability to translate verbal statements (a) in mathematical form using appropriate symbols, and (b) diagrammatically
 - iii) Ability to make reasonably good approximations and estimate measurements
 - iv) Ability to apply mathematical concepts and skills to solve simple problems of day to day life
 - v) Ability to think logically, and
 - vi) Ability to recognize order and pattern
4. To make the mathematics curriculum relevant to (a) the needs of the society, and (b) the personal needs of the learners.
5. Children belonging to different social, economic and cultural background, including first generation learners, should avail of equal schooling facility as well as equal chances of being successful.
6. We should have future-oriented education, as the preparation of the child for his/her future life is one of the goals of education.