Development of skills

 Computational skills, Geometrical skills,

 Drawing and interpreting graphs and charts.

In mathematics the following skills may be developed. Some of these skills are not purely psychomotor; they have to be integrated with the classes of objectives under cognitive domain.

1. **Skill of computation**
2. **Skill of drawing figures**
3. **Skill of drawing graphs**
4. **Skill of reading tables**

In detail, the pupil acquires following skills, through learning of mathematics

1. Computation
	* 1. Carries out oral calculations with ease and speed
		2. Carries out written calculations with haste and speed
2. Drawing geometrical figures and graphs
	* 1. Handles geometrical instruments with ease and proficiency
		2. Measures accurately
		3. Draws freehand figures with ease
		4. Draws figures to specifications or to scale
		5. Draws figures accurately
3. Reading tables, charts, etc.
	* 1. Read tables with speed and accuracy
		2. Interprets graphs

Computation skills

**Speed with accuracy** is indispensable for effective mathematics learning more than in any other subjects. Precision and accuracy are the important features of mathematics as a discipline. Mathematical rules and principles are absolutely right or wrong and the students should also be trained to arrive at accurate solutions to mathematical problems. They should also be trained to reach these right solutions with speed and ease. We cannot sacrifice one or other. The students should be trained to carry out the mathematical tasks with speed and accuracy.

**Ways of developing accuracy**

The teachers of mathematics will have to make conscious efforts to develop in students the accuracy in mathematics. The following will be helpful for the same:

1. Memorization and habit formation

The students quite often make mistakes in numerical computation. Therefore all the fundamental computations should be thoroughly memorized and habituated so that required response to any number situations becomes automatic. Drill is an effective means of memorization and habit formation. Also knowledge of principles helps to make pupils remember facts and to form habits quickly. However care should be taken that the students do not resort to rote memorization, instead they should be trained in meaningful memorization of principles and formulae.

1. Use of oral questions

Oral questions can be asked to make the method of solving a problem clear before they are asked to solve a problem in the writing form. Once the method is clear, the students will be able to solve it accurately

1. Developing the habit of understanding and analyzing the problems

Students make mistakes because they do not understand the statement of the problem or analyse it properly as to what is given, what is to be found out among the given data and so on. Frequent practice in understanding and analyzing the problem through the stimulating and thought –provoking questions can help students in a very significant way to increase accuracy in problem solving

1. Employing diagnostic test and remedial measures

Diagnostic tests will find the causes of inaccuracy and the teacher can provide suitable remedial programmes for the removal of errors, leading to greater accuracy

1. Legibility and proper placing of figures

The students should be trained to write figures correctly, legibly and in good handwriting. Rough work should not be done along with fair work. It should be done in the margin perfectly. If the figures are placed correctly, there is very little likelihood of inaccuracy.

1. Ability to copy out figures correctly

In mathematics, sometimes students have to copy out figure from other places. This copying has to be done cautiously, properly and correctly. In this regard students should be trained to copy out figure at primary stage of education.

1. Verification of results

This leads to accuracy. If a student finds that his result is true by verification, he feels satisfied and develops the habit of verifying the results. In verification, students should be encouraged not only to verify the last result, but should be encouraged to verify all the steps.

1. Encourage the students to make correct statements

It the students are not able to write correct statements, he is likely to develop the habit of inaccuracy. The correct statements and their right sequence lead to the correct solution to the problems. This should be made known to the students and adequate training in this aspect could considerably enhance the accuracy of their mathematical work.

**Techniques for developing speed**

Speed can be developed by adopting the following techniques

1. Developing of accuracy

Once accuracy has been developed, it is easy to develop speed. A person who does things correctly and speedily must be rewarded. It is therefore necessary to develop accuracy

1. Habit formation

Teacher must help students to develop the habit of doing figure works correctly. This in turn develops accuracy and thereby speed.

1. Time limit

Student should be asked to do things within a limited time, which help them to do correctly as well as quickly

1. Use of shortcuts and formulae

Students should be made aware of the short cuts even when we teach them in the activity or process oriented manner. Also they must be trained to recall all formulae as and when needed.

1. Use of mathematical symbols and language

Speed can be increased by making the statements in a concise and precise form using mathematical language and symbols.

1. Discourage the use of material aids

The interest for accuracy, efficiency and speed is seen to decline with the use of calculating machines and other material aids. So try to avoid use of the same.

1. Too much use of statements and figure

If a lot of language is employed, in doing math problem solving, it hinders the systematic step writing. Too much use of figures also, retard speed and accuracy in doing math problems.

1. Psycho-physical needs of students

While giving math problems the individual difference and the psychological needs of students must be catered. If the same level of questions are provided for the bright student and dull student of the class, their ability for maintaining accuracy and speed is likely to get reduced.

**Importance of Mental calculations**

 Mental calculation is the practice of doing mathematical calculations using the human brain alone: that is with no help from any computing device. Practically, mental calculations are not only helpful when computing tools are not available, but they also can be helpful in situations where it is beneficial to calculate with speed.

Advantages of mental calculation

1. Mental calculation sharpens the mind and increases the mental ability and intelligence
2. Mental calculation improves the memory. Memory depreciates if it is not exercised. Short term, long term memory all are stimulated by mental calculation
3. Mental calculation creates confidence in oneself and in ones capabilities.
4. Mental calculation leads naturally to the search for, and discernment of, constancy and law, which are very necessary attribute in the rapidly changing world.
5. Practical uses of mental calculation are many, since we all need to make quick calculations from time to time.
6. Mental calculation leads naturally to innovation and to the invention of new methods , thereby developing the students natural creativity.
7. It enhances the precision of thought. Numbers and other mathematical objects are unbiased; giving only one correct answer to which everyone will agree-there is never a contradiction. This absolute precision is unique to mathematics, so dealing intimately with numbers, as we do in mental calculations, we cultivate fine and careful thinking
8. Our mind has the ability to retain several ideas at once so that they can be compared, combined and so on. This facility is enhanced by mental calculations.
9. Through mental calculation one become familiar with numbers and appreciates their various properties. This leads to real understanding of numbers
10. Mental calculation is a delight to the mind, the intrinsic qualities, relationships and beauty of numbers and the way they create new numbers out of themselves is a source of great enjoyment

Mental calculation really brings mathematics to life as well as providing motivation, strengthening and energizing the mind.

**Role of Drill work**

Drill work is based on the psychological principles such as learning by doing and law of exercise. The purpose of drill is to increase proficiency in performance. The speed and accuracy in mathematics cannot be developed without drill work. Simpson defines “Drill is a serious work activity or the strengthening of association to make skills more permanent”.

The following are the functions of drill work

1. Help in fixation of rules, principles and formula already acquired by the students
2. Strengthen the connection between related concepts
3. Provide essential means of attaining some of the desired controls
4. Helps in increasing speed and accuracy in solving mathematical problems as the learners become proficient in mathematical skills and operation
5. Help in the automatization of mathematical facts formulae, operations and skills through systematic and repeated practice
6. Help in habit formation
7. Are helpful in remedial work
8. Help in providing greater efficiency in the use of knowledge that they have acquired
9. Help in improving self-confidence through a sense of achievement
10. Provide stimulus for further learning
11. Provide encouragement for slow learners and average students

Geometrical skills

Teaching of geometry is significant because

1. It brings about cultural development and is key to mathematical thinking
2. It has a demonstrative value and develops power of reasoning
3. It provides opportunity for observation and exercising the process of deductive logic
4. It is helpful in providing career to the students
5. It is also helpful in providing knowledge about certain aspects of life.

The mathematics teachers have now began to realize the nature and practical arts of teaching geometrical skills

1. The emphasis will be on the understanding of fundamental concepts and techniques such as meaning, drawing and use of lines, angles, triangles and polygons
2. The pupil must acquaint himself with the common geometrical concepts and figures
3. They will be mainly guided to experience the symmetry, variety, regularity in nature, thereby they are able to increase their geometrical aptitudes and interest
4. They will be taught how to keep and handle the geometrical instruments. The commonly used geometrical instruments are scale-for measuring length and drawing, protractor-for measuring angles, compass for drawing circles, set-squares –for drawing parallel lines
5. Drawing of geometrical figures helps in the development of drawing skills. The major factors in construction like clarity, brevity, neatness, simplicity and accuracy are inculcated properly in students

Scale drawing: Once the students have been taught about the use of different instruments they should be taught to draw different figures according to some scale. The importance of neatness and accuracy in the subject should be explained to them and should be encouraged to draw lines neatly and accurately. If they learn about these things, they shall be able to learn geometry in a correct and proper perspective.

Angles: Students should be told about angles and asked to draw and measure some angles. Once they have learnt about it they should be told about different types and kinds of angles such as right angle, acute angle, obtuse angle, etc. this is considered to be one of the basic concepts of geometry which is to be explained properly.

Parallel lines: Once the students have been told about the concept of lines they may be taught parallel lines. This may be done with concrete examples. They should be asked to draw parallel lines on their books using scale and set square. After these topics, congruency, similarity, locus, etc. should be taught. After making these concepts clear theorems and corollaries should be taken-up. Proper symbolic notation, translation of exercises into figures, accuracy of language and the direction to the students occupy an important place in teaching of geometry.

Free-hand drawing: In geometry the problems are solved with the help of construction. In demonstrative geometry the first thing is to translate the statement into a figure and to mark in the figure properly. The free hand construction should look neat and accurate. It should be fairly large in size and reasonably neat. Erasing should be avoided.

Efficiency in construction requires skillful management of geometrical instruments. The instruments permissible are straight edge for drawing straight line. Compass for drawing arcs and measuring length of lines. Lack of practical experience is generally responsible for students to draw accurately. Constant practice is the only way to acquire self-confidence in construction work. Accuracy and neatness requires good and accurate geometrical instruments.

Drawing patterns: One of the essential features of mathematical thought is the evidence of pattern. Patterns can be made by drawing using squared paper or ruler and other instruments. A greater element of enjoyment is attainment through colouring the patterns, especially for the less able children. Rectangles or squares of coloured paper can be folded in different ways to give different shapes. These can be cut out and stick on a sheet of paper to form pattern. Some work on pattern can lead to the study of the space filling shapes. The practical problem of tile shapes to cover a floor will show that besides the square or rectangle tile we can use equilateral triangles.

The teaching of geometry helps the students to acquire the following abilities:

* It enables the learner to acquire a mass of geometrical facts
* The geometrical principles of equality, symmetry, and similarity are implanted in the very nature of things
* It is important in a person’s cultural development
* It develops the ability to draw accurate plans
* It demonstrates the nature and power of pure reason
* It is the key to mathematical thinking
* It is useful in engineering, construction, industries, landscape, architecture, interior decoration and other areas of appreciation

Drawing and interpreting of tables, charts and graphs

**Skill of drawing graphs:** By developing skill in drawing graph, pupil tabulate the co-ordinates correctly, plots the points neatly and correctly and also interpret the graph.

**Skill of reading tables:** By developing skill of reading tables, pupil reads the table correctly and read the table with speed and accuracy.

Tables, graphs and charts come in the category of visual aids. They give a visual representation and summary of factual information. A table provides a large amount of information in a condensed form. A graph illustrates statistical information in a single way. A chart visually illustrates large or small amount of information.

How to use tables, graphs and charts

1. The teacher should make use of every opportunity to enhance the lesson with visual illustrations. Therefore, whenever a table, graph and chart would assist students in their learning, the teacher should prepare visual aids and integrate them into the lesson.
2. The teacher must ensure that all students have the skills required to interpret the visual aids
3. The teacher may have to prepare lessons or assignments so that students can practice and perfect these skills
4. The teacher should have clear objectives for using visual aids and ensure that students have learned the necessary information presented in them.
5. The teacher should sketch out any visual aids prior to the lesson, if he or she is going to draw table, chart or graph during lesson.
6. The teacher should give the students adequate time to study and interpret any visual information, before it is summarized by the teacher.
7. The teacher should not assume that students have assimilated and understood all the valuable information
8. The teacher should link together the textural and visual information into a unified whole.
9. The teacher can teach and practice many inquiry skills through the use of graphs, tables and charts- drawing inferences, interpreting the tables and drawing a conclusion, evaluating information and valuing