Chapter-IX

Mathematics laboratory

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Laboratory is a place which serves two-fold purposes. Firstly it provides safe and proper place for placing all the essential material and equipment concerning the learning activities in a subject. Secondly it gives proper facilities and opportunities for the essential practical work and lively learning experiences. In this way laboratory provides a good platform for the integration of theory with practice in subject.

Mathematics laboratory is a place or room where mathematics material and equipments are placed for students to conduct the practical. In the mathematics laboratory, all those facilities are provided which are necessary for students to do practical. Practice makes a man perfect. Different apparatus and environment- is needed in the mathematics laboratory for the practice. In mathematics laboratory students gets both apparatus and environment, by which they can understand subject more deeply. So in each school, mathematics laboratory should be necessarily.

Laboratory method and other experimental methods can be introduced in the schools only through the establishment of a mathematics laboratory.

NEED AND IMPORTANCE OF MATHEMATICS LABORATORY

The mathematics teacher has to make use of laboratory for doing practical and projects, displaying charts, models etc. To keep all equipments and other material in a safe custody and for easy availability, it is necessary to have a separate room for mathematics subject. This separate room is called as mathematics laboratory. It creates the conducive environment for learning subject. Mathematics laboratory is needed for following purposes:

(1) **Provide Safe and provide place:** laboratory provides safe, secure and proper place for placing all the essential costly equipment required for learning activities in subject.

(2) **Developing Scientific attitude:** It helps in creating and promoting scientific attitude among the students.

(3) **Saves Energy and time of students:** As everything is well arranged in a laboratory, students come and perform practice work without wasting time and energy.

(4) **Creates self-discipline:** Students keep themselves busy in doing practical work according to their abilities, interest, need and capacity and proceed towards self-activity. Thus maintaining self-discipline.

(5) **Developing abilities and skills of students:** Mathematics laboratory develop application abilities, problem solving ability and various skills like experimentation, observation etc.

(6) Use of various Teaching methods: In mathematics subject various, teaching methods such as laboratory method, project method, CAI, etc. are used. All these method require special room where each student can be provided with necessary equipments.

(7) **Creating Interest for learning computers:** Well equipped, arranged laboratory. Creates interests in subjects in students for learning.

(8) **Providing congenial Environment:** The arrangement and setting of equipment, sitting arrangements and overall environment of the laboratory provides congenial environment for performing the practical with concentration.

(9) **Integration of theory and practice:** It provides a place for the integration of theory and practice.

(10) **Hub for logical thinking:** Students have to write and derive mathematical formulae's, for all this, they require a room where they can think logically. Thus mathematics laboratory is a hub for logical thinking.

(11) **Effective and permanent knowledge:** The knowledge which a student gains by his own work is more clear, permanent and effective.

(12) **Equity:** Everyone have equal access to all the equipments. This is both equitable and engaging for the students.

(13) Group work capability: Having mathematics lab in the school is the capability to train at the same time. If there is a particular problem or application which the teacher wants the students to learn and master, the whole class can be given instruction on it at the same time.

(14) **Online Tools:** Many online tools can be used by teachers to make learning more fun, interesting, and easy to understand. Teachers can add flavor of any lesson, whether with additional pictures, and other educational tools. Classroom-oriented games can be found at sites such as class tools net and fun brain.

(15) **Development of Interpersonal Skills:** Lab work or practical work carried out in pairs or small groups can help students to develop a wide range of basic team skills, effective valuable educational experience can be provided by learning with peers, supervisors, demonstrators and support staff.

(16) **Developing sense of co-operation:** While working in laboratory, students develop a sense of cooperation and spirit of healthy competition.

(17) **Satisfying the curiosity:** mathematics laboratory helps in satisfying the curiosity of the students.

(18) **Projects Completion:** The projects assigned to students can only be done in the laboratory.

(19) **All time availability:** All time availability of the apparatuses is provided in laboratory. The students whenever need may go to laboratory and perform practical.

(20) **Providing functional environment:** Functional environment provide by well-equipped mathematics lab. The physical equipment like computer, LCD projector, speaker, printers etc. provide

A work room for the pupils because activities and practical solution of the problem can be taken over there.

EQUIPMENTS AND COMPONENTS OF MATHEMATICS LABORATORY

Mathematics Lab is a room for practical. Mathematics Lab should be properly and adequately equipped in order to give good practical experience to the students. There are a lot of equipment and material which can be placed in a Mathematics Lab. For schools it is not possible to place all the equipment and materials in the mathematics laboratory due to economic problem. So the material is divided into two categories:

(a) Essential Equipment

(b) Desired Equipment

(A) **Essential Equipment:** This category includes all hose equipment, material and resources which are necessary in the mathematics lab without which a mathematics lab cannot work. The essential equipment or materials of the mathematics laboratory are listed below:

(1) **Infrastructure:** The first requirement for a mathematics laboratory is a availability of a well spaced room. It should have basic facilities like lightening, ventilation system. The power arrangement etc..The next in infrastructure is the availability of white boards, teacher table, dice, teacher chair and sufficient furniture for sitting of students. This may include stools and chairs etc. The laboratory room should also have one or two almirahs.

(2) **Concrete Material:** In the concrete material, there may be beads, ball frames,number cards, sticks, colored balls, pebbles, of different shapes and colours, toy money, matchbox, scissors, pins, nails, rope etc. This type of concrete material should be placed in labortary.

(3) **Charts and Pictures:** Mathematics laboratory should have the colorful pictures and charts related to various topics of mathematics showing application of mathematics in daily life. Some pictures of great mathematicians and their contribution in the field of mathematics should also be placed properly.

(4) **Models:** Different type of models like, squares, triangles, spheres, cones, thick card-board sheets of various lengths and breadth should be placed in mathematics laboratory.

(5) **Weighing and Measuring instruments:** Weighing and measuring instrument are the most important things in a labortary. Different types of weighing and measuring instrument are measuring tape, meter-rods, physical-balance, spring-balance, weights of different measures, fractional weights, graduated cylinders etc.

(6) **Surveying Instrument:** Following surveying instruments should be part of labortary.

Angle Mirror-It is useful for laying right angle in the field.

Sextent- It is useful for finding out the angle of elevation and depression, altitudes of a body and width of rivers, bridges etc.

Level- It is used for leveling the surfaces. It is necessary in contour mapping, general surveying and civil engineering.

Hypometer and clinometers- It is a combined instrument used for finding angles of elevation and depression and for measuring distances and heights of objects indirectly.

(7) **Computer system:** The next requirement for a mathematics laboratory is availability of sufficient number of computer systems. The number of computers depends upon the numbers of students who are going to use the lab because a single computer is desired for a single students. But this desired is not possible to have due to economic problems. So. at such situations two students may share a single situations two students may share a single computer in the lab. All the computers should be equipped with CDROM 8 / DVDROMs, UPS, Keyboard, mouse, speakers,

monitor as minimum. In the lab there should be a separate computer for the teacher.

(8) **Drawing Instruments-** For the drawing and sketching of various figures and diagrams there should be drawing instruments in the laboratory. Wooden instruments of big size are meant for teacher use and the smaller one are placed in a geometry box for the students.

(9) **Projection Media:** The mathematics laboratory should be equipped with proper projection media. A LCD projector is used as a projection media in the laboratory. It should be connected to teacher's computer and should be fixed properly so that no time should be wasted in order to start it. LCD projector should be always in ready position to use it.

(10) **Slide Rule-** It is one of the most interesting and important instrument in the mathematics labortary. It provides a rapid means of multiplying and dividing numbers, of taken certain powers, finding roots etc.

(11) **Calculating machines-** At least one calculating machine for demonstration purpose should be placed in mathematics laboratory. It can do all sorts of calculating in very less time with great accuracy.

(12) **Proportional Divider-**It can be used to enlarge or reduce maps, diagrams, or pictures. It is based on the principle of proportionality of similar triangles.

(13) **Instructional Material-** Instructional material, such as computational skills development material like work books, calculators etc. Instruments that will assist in diagnosis student's needs, weaknesses likes various mathematical games, riddles and puzzles etc.

(14) **Reference Material-** Reference material includes some reference books, text-books, magazines, mathematics journals, books containing old and latest literature related to subject matter.

(15) **Software :** The another essential part of mathematics laboratory is the availability of all types of software to the students. The software list should be according to the curriculum of the students. The systems in the lab should have properly installed licensed versions of all the software which are needed for the students. The installers of all the software should be kept away from the reach of students under teacher's custody.

A few software which are almost required by all the classes are MS-Window, MS-Office, DOS, Anti Virus, Encyclopedias, etc. The other softwares which are according to curriculum may be included

(16) **Internet Facility:** Internet is the gateway of information to the outer world. Today Internet has become an essential for the teacher and the students. So a mathematics laboratory should not be considered as a complete laboratory without the availability of internet facility. A broadband connection is always preferred for the adequate speed of Internet.

(17) **Networking:** All the computer systems should be properly networked to each other. This networking system should be attached to teacher's computer which should be properly wired and no wire should be left open in the mathematics laboratory.

(18) **Teaching Aid material:** The lab should have adequate numbers of teaching aids which should be properly stored and displayed. This may include the charts, models, software packages, presentation etc.

DESIRED EQUIPMENTS:

This category includes all those equipment which are not essential but the availability of these equipment is desired in order to have better functioning of education. They include:

(1) **Bulletin Board:** A bulletin board should be placed in the laboratory at the appropriate place. This bulletin board can be used to display relevant cutting and pictures collected by the students. This board may also be used to display the latest information related to mathematics world.

(2) **Collection corner:** A corner in the laboratory should be reserved for pictures, newspapers, journals, related to mathematics from where the students may have any kind of information whenever they desire.

(3) **Display Material:** A laboratory should have adequate display material in the form of pictures, diagrams. Thus may be displayed on the walls of the laboratory. As soon as a person enters in laboratory he should feel that he has entered into a learning room. This has a psychological effect on the learner. Thus they prepare themselves for learning.

(4) **Setting Arrangement:** Seating arrangement should be done according to the arrangement of tables. Although tables are fixed yet chairs should be movable and easy to rearrange for a variety of purposes like teacher's lesson or group work.

DESIGN/ SETTING UP THE COMPUTER LABORATORY

For setting a computer laboratory, the quality and quantity of the equipment and material needed should be properly planned, procured and preserve.

(1) **Planning:** Flexible planning of mathematics laboratory should be done. In its construction, engineer, architect and educationist all play an important role. Following points should be kept in mind while planning:

(i) **Work Space:** The first step is to see available work space where students can work comfortably. Depending upon the building, type of school, number of students, laboratory can be set up on ground floor as well as on every floor. Due consideration should be given to ventilation, sunlight while setting a laboratory. The room should be facing north so that proper amount of sunlight and fresh air may be possible.

(ii) **Equipment:** The list of equipment should be prepared after careful consultation of the prescribed syllabus.

(iii) **Finance:** This is most important aspects of planning because without financial aid laboratory cannot be set up. So before ordering equipment provision of annual budget should be taken into account. Purchase should be on basis of priority. Depending upon budget, laboratory could be equipped with various types of equipments.

(iv) **Number of students:** Number of students studying mathematics subject or visiting mathematics laboratory also play important role in planning.

(v) **Type of School:** Type of school (public or government), how frequently mathematics laboratory is used interest and willingness of teacher etc. also affect the planning part.

(2) **Designing:** After planning, next step is to prepare a rough sketch of the mathematics laboratory. It could be shape or shape, depending upon the space available.

(3) **Furniture and Fitting:** As regards to furnishing and fittings of laboratory, it should be equipped is such a way as to provide for all types of class room activities like demonstration and laboratory work. Fixed type of tables may be kept along the walls lengthwise for the students.. One demonstration table for the teacher should be there. Tables, chairs, white board, projection screen, separate server room, channel railing, provision of air conditioner, shoe rack, bulletin board, should be in mathematics laboratory.

(4) **Placing the equipments:** Equipments should be placed at proper place as specified by the architect or engineer.

MAINTENANCE OF MATHEMATICS LABORATORY/ ESSENTIAL SAFETY MEASURES TO MAINTAIN EQUIPMENTS

There are expensive and delicate equipment like hardware and software in a mathematics laboratory that have to be looked after properly. The following points should be kept in mind for the safety of the equipments.

(1) **Safety of Equipments:** To protect the equipments, following precautions should be taken.

(i) **Protection from Dust:** Dust is the greatest enemy lf the equipments. The best protection from dust is to cover the equipments with a dust cover whenever the machine is not in use. The dust cover can be of plastic or cotton material.

(ii) **Lock the Equipment:** Always keep the equipment under lock and key. This will avoid stealing of equipment and no one can damage the equipment.

(iii) **Protection from liquid:** Liquid can also do harm to the hardware. So students are not allowed to take any liquid when they are working in mathematics laboratory.

(2) **Safety Measures:** laboratory should have various safety measures like safety from fire, electric short circuits.

(3) **Presence of teachers:** Teacher should always be present in the laboratory when the students are working in the laboratory.

(4) **Maintenance of discipline:** Proper discipline should be maintained so that the students should not create any mischief and nothing should harm to them and to the equipments.

(5) **Awareness to Students:** Students should be made aware that equipments are costly. They should be handled with care.

(6) **Instructions to Students:** Beforehand, instructions should be given to the students about the functioning of the equipments and rules to be followed in the laboratory.

Discipline in the Laboratory rules for the teachers and laboratory staff

(1) Teacher and the laboratory staff should not allow any student or person to enter the laboratory in their absence.

(2) The teacher and laboratory staff themselves should produces self- example for the proper use and maintenance of the laboratory.

(3) Teacher and laboratory staff should exercise proper control over the student working in the laboratory.

(4) The seats of the students should be fixed. They should not be move here and there in the laboratory.

(5) Full instruction about the conduct of the practical should be given to students before the beginning of the practical.

(6) The teacher should have full knowledge of the practical items and requirements used by a student in his seat at the time of practical class.

(7) All precautions to be adopted by the students during their practical should be told to the students.

(8) The students should switch off electrical connections before leaving his place of work.

(9) The work of the students should be under the strict control of the teacher.

(10) The disciplinary rules and precautions to be adopted in laboratory should be exhibited.

RULES FOR THE STUDENTS IN THE LABORATORY

The students while working in the laboratory should be instructed to follow the following rules:

(1) All equipments must be handled with care.

(2) No article should be taken outside the laboratory.

(3) Use only those articles needed for the practical.

(4) In case of problems, the teacher must be informed.

(5) No haste should be done in performing practical.

(6) Nothing should be left on the floor. If there is any obstruction it should be removed at once.

(7) After the practical all equipments must be cleaned and switched off.

(8) In case of doubts, the teacher must be consulted.

(9) Perfect discipline should be maintained and useless talking should be avoided whole performing practical.

REGISTERS IN COMPUTER SCIENCE LABORATORY

Following registers are generally maintained in Schools

(1) **Stock Registers:** They are of three kinds:

(i) **Register for Breakables:** In this register, first instance of all damageable (hardware) are entered in different categories.

(ii) **Register for non-breakables articles:** This contains details of items which are not liable to be consumed or broken, like software etc. Also, in this register one could enter the working and non-working models, the laboratory has, like charts, flex etc. certain other articles like pen drive etc. can be added in this register.

(iii) **Stock register for consumable items:** Consumable articles are entered in this register.

(2) **Purchase Register:** The bills in full, of all article purchased must be entered with all the particulars such as:

- Name of the firm.
- Date on which the goods received.
- Rate of each item.

- Number of articles purchased.
- Total cost of the articles.

(3) **Necessity Indicator Register:** The teacher should go on nothing down any system, article or other necessary items not in the stock but needed urgently for conducting experimentation in the laboratory. This is of great help in making annual demand and framing budget for laboratory expenditure at the end of each year.

Exercise

SHORT ANSWER TYPE QUESTIONS

(1) Discuss the need and importance of mathematics laboratory.

(2) What are the rules of mathematics laboratory for the teachers and laboratory staff?

(3) Describe the rules of mathematics laboratory for the students.

LONG ANSWER TYPE QUESTIONS

(1) Discuss the planning of mathematics laboratory in a school.

(2) What is the importance of mathematics laboratory? Draw a detailed plan of mathematics laboratories for a secondary school.

(3) Discuss the essential equipments required for mathematics laboratory.

(4) Plan and discuss a mathematics laboratory for high school.

(5) What are the physical conditions and layout of a mathematics lab in an educational institute? Discuss the importance of mathematics lab.