

## TOWARDS EFFECTIVE LABORATORY INSTRUCTION

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### ABSTRACT

*Laboratory work in Engineering Colleges and Polytechnics forms a major part of providing instruction to the students. The present methods of imparting laboratory instruction do not appear to be effective. An attempt is made in this paper to analyse and identify lacunae and suggestions are made to reorient and reorganise the laboratory work so that instruction become effective. It is hoped that all those concerned with laboratory instruction would consider the thoughts expressed and make attempts to improve laboratory instruction.*

### 1.0 INTRODUCTION :

The curriculum of degree or diploma programme for any discipline has two major components viz. lectures and practicals. Both these components aim at transferring the knowledge and developing appropriate skills in students so that when the students enter in the field-work they are able to apply the same in solving the problems. It is observed that the laboratory work assigned for a particular subject intends to supplement or reinforce the theoretical contents. It would be worthwhile to analyse the present position before suggesting new approach for effective laboratory instruction.

### 2.0 PRESENT POSITION :

A detailed study carried out by the author, of the present position in

respect of the nature of laboratory experiments, method of conducting the same and assessing laboratory work has revealed many points. Major findings are as follows :

- Laboratory work is assigned a secondary role and therefore handled by junior teachers.
- Students are not interested and many are tempted to resort to copying from old journals without understanding the work they carryout.
- Laboratory work is neither challenging nor motivating to the students.
- No well defined objectives for laboratory work exist resulting in random and disjointed work.
- As there are prescribed experiments there is little flexibility for building in innovative experi-

ments.

- The experiments mainly tend to verify theoretical principle.
- The laboratory work has no relevance to the field problems.
- The assessment of students laboratory work does not have the right focus.

In view of the present state of art it is essential to ask ourselves a critical question what is to be achieved through laboratory work ? In the absence of suitable answer, the teachers may continue to carryout the ritual work in the laboratory and students would be interested in merely submission because it is compulsory. Remedial measures are suggested which will provide answer to the critical question and make laboratory instruction effective.

### 3.0 RESTRUCTURING LABORATORY WORK :

The aim of engineering education at degree level is to prepare technical manpower termed as professionals to help industries in solving the problems in the field. This suggests that in addition to technical knowledge the passout from engineering colleges should possess certain skills and abilities to solve the problems in the field. Such identified skills and abilities can be developed only through the laboratory work and not through classroom instruction. Following are the objectives suggested for the laboratory work which can be achieved, by suitable approach for conducting the experiments and following the suitable techniques of assessment of students based on the objectives.

Objectives of Laboratory work - At the end of laboratory work student will be able to -

- i) discover rules and relations
- ii) develop the ability to observe and measure physical phenomena.
- iii) select suitable equipment, instrument, material
- iv) identify sources of errors
- v) develop operational skills
- vi) interpret the results and events
- vii) follow standard test procedures
- viii) analyse unknown problem
- ix) locate faults in equipment, instruments, circuits
- x) work as member and leader of the team.

Above objectives can be achieved through the total laboratory work during 4 years of the degree course. It may not be possible and feasible to achieve all these objectives in the laboratory for one subject. It is therefore desirable to identify the objectives which can be achieved through the selected laboratory. For example 6 objectives may be identified for Fluid Mechanics Laboratory. Further depending upon the number of experiments in that laboratory it is possible to consider major objectives for each experiment. It may be mentioned that not more than 2 or 3 objectives be considered for one experiment. This leads to developing specification grid for one laboratory. In this grid objectives for a particular laboratory are written along X axis and names of experiments on Y axis (as shown below). Tick mark against each experiment shows the objectives to be achieved.

| Specification Grid                   |            |                   |      |      |     |          |
|--------------------------------------|------------|-------------------|------|------|-----|----------|
| Name of Laboratory : Fluid Mechanics |            |                   |      |      |     |          |
| Names of Expts.                      | Objectives | Objective Numbers |      |      |     |          |
|                                      |            | (i)               | (ii) | (iv) | (v) | (ix) (x) |
| 1                                    |            |                   | ✓    |      | ✓   |          |
| 2                                    |            | ✓                 |      | ✓    |     | ✓        |
| 3                                    |            |                   | ✓    |      |     | ✓        |
| 4                                    |            | ✓                 |      | ✓    |     | ✓        |
| 5                                    |            |                   |      |      | ✓   |          |
| 6                                    |            | ✓                 |      |      | ✓   | ✓        |
| 7                                    |            |                   | ✓    |      |     | ✓        |

The above grid will be useful in designing the experiment, conducting the experiment and keeping proper focus on assessing the students.

Once the laboratory work is re-structured on the basis of objectives through specification grid the teacher can design the experiments to achieve the identified objectives. The different types of designing the experiment are explained in the next section.

#### 4.0 DESIGNING EXPERIMENTS :

It is necessary to adopt different formats while designing the experiments. Eventhough the title of the experiment remains same as mentioned in the list, suitable format can be devised to fulfill the objectives for that experiment. Following are types of designing experiment. Key points are given for each type of experiment.

(i) **Discovery Type** : This type is suitable for experiments where there is relationships between variables. Teacher has to provide instructions in sequential steps with built in questions

for students to answer. To focus on certain concepts teacher can state some statements.

(ii) **Investigation Type** : This type is suitable where student is expected to make selection either in material, instrument or equipment after analysis. It is presumed in such experiments that student has acquired some skills to perform the experiment. The format is kept open ended and students are asked to provide methodology of investigation. This type of design attempts to inculcate thinking ability.

(iii) **Problem Solving Type** : This type is suitable for experiments in which there are no definite solutions. Teacher will have to search for such problems which will be within the scope of students. In this type teacher provides problem statement and asks the group to give all details of carrying out the experiment.

If different types of experiments are designed by the teacher, experiments will become interesting and challenging to the students. Once experiments are designed, the skill of the

teacher lies in conducting the experiment. Some hints are given to teachers in the next section.

### 5.0 CONDUCTING EXPERIMENTS :

While conducting the experiments teacher has to ensure that predetermined objectives are achieved. Some suggestions are given below :

- (i) Plan the laboratory for the complete year in advance.
- (ii) Students be made aware of their participation in laboratory work at the beginning itself based on achieving the objectives.
- (iii) Ensure that students know what they have to do in each experiment.
- (iv) Provide freedom to the students to interact freely with you.
- (v) Provide guidance to the students when it is essential.
- (vi) Watch the process in the laboratory so that students become interested in learning and not in submission.
- (vii) Develop habit of recording feedback good or bad when you make innovations in laboratory.

### 6.0 ASSESSMENT OF STUDENTS :

Normally the marks are allotted to

the work carried out by the students for the practical work as prescribed in the curriculum. This is considered as assessment of student at present. Marks are indicators of performance. It is necessary to change the focus of assessment.

It is suggested that some criteria based on objectives be evolved to assess the performance of students. The students be made aware of the criteria and expected standard of performance. It is bit difficult in the initial stage to derive the criteria. However, developing skills and abilities in students is possible with the help of process assessment based on predetermined criteria. Continuous assessment throughout the year will enable students to judge their achievements.

### 7.0 CONCLUSION :

The approach based on objectives is the need of the hour to derive maximum benefit from the time allocated to laboratory instructions. This will enhance student's participation in laboratory work and students will find interest to work in laboratory.

