SKILLS DEVELOPMENT THROUGH LABORATORY WORK

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(1) INTRODUCTION

As we all know the aims of technical education is to produce technical personnel possessing the minium required competencies and certain desirable attitude to perform one's job successfully when the student joins the industry after passing out from a technical institution. The author believes that the intended competencies are not developed automatically, but a concerted endeavour will have to be made and innovative laboratory experiments will have to be intentionally designed to achieve them. This paper tries to spell out a philosophy in designing the laboratory experiments for the achievement of the competencies.

Fig. 1. : Depicts a typical estimate of the quantum of knowledge and skills that are required for different categories of technical manpower working in the industry (4). It also gives an idea of the range of skills that one has to perform. If these skills are intended to be achieved through the laboratory work and field work, the laboratory experiments need to be so designed to attain the predetermined skills with respect to each discipline.

Fig 2 : Visualizes a continuum of laboratory/field experiments that are possible, with teacher-centred experiments (conventional type) at one end to totally student-centred experiments (project work) at the other end. The author believes that a student will not be able to independently do a job confidently just by doing one project work at the end of final year of the diploma programme or degree programme because the switchover from the conventional type to the project type cannot be very sudden. An attempt is made in this paper on how to bring about this smooth transition in a phased manner over a time period.

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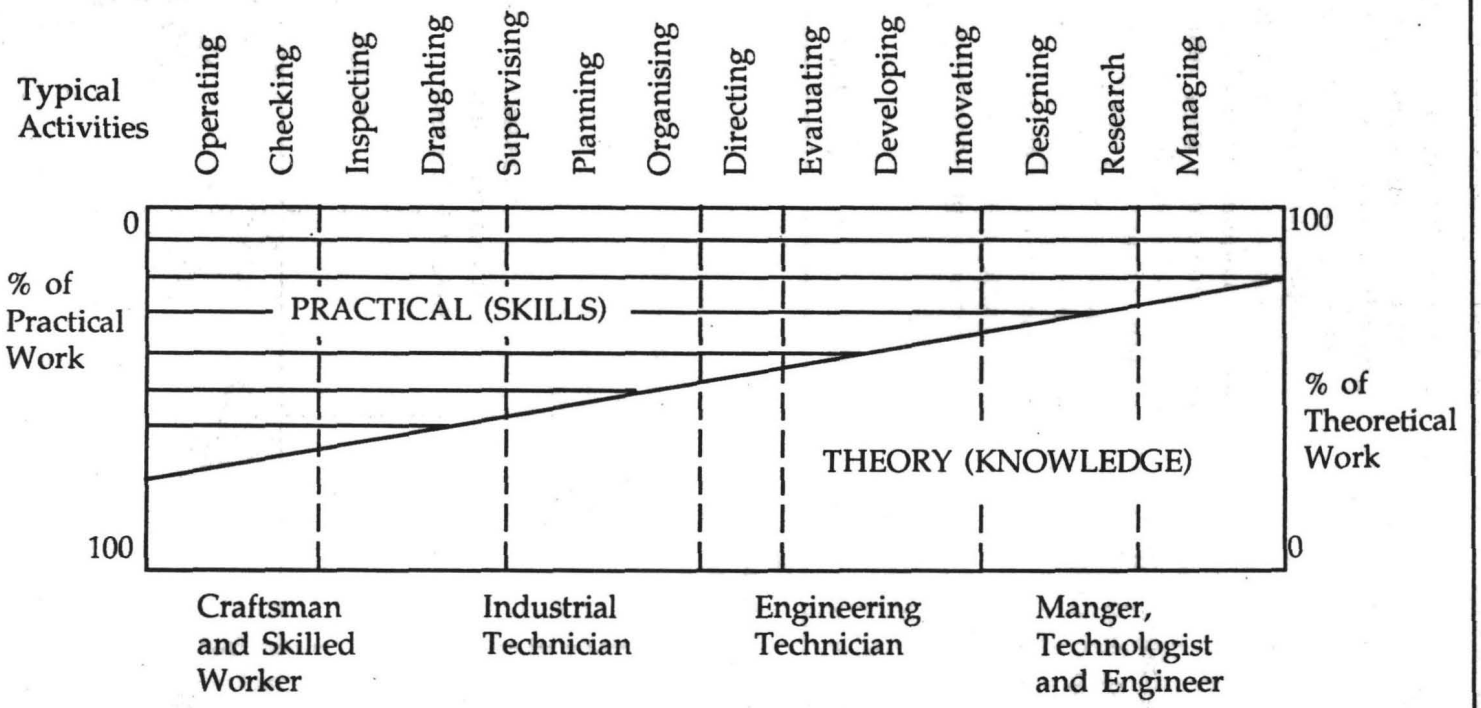
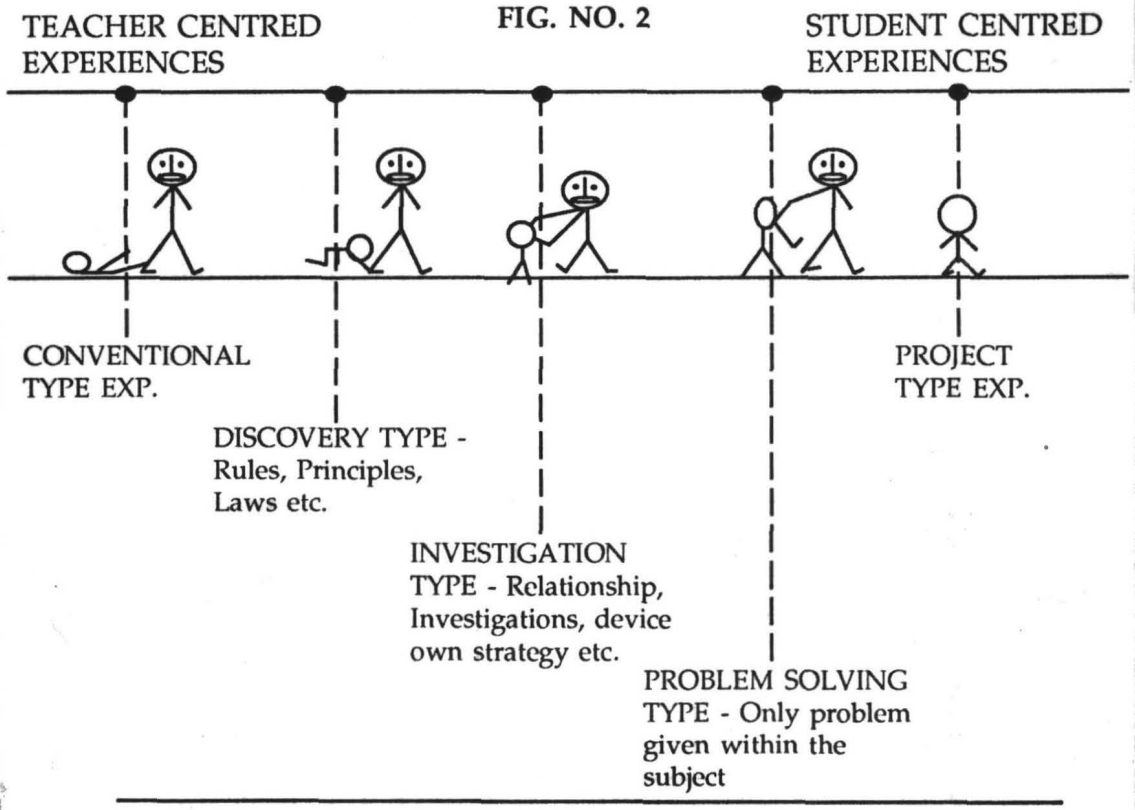


FIGURE 1 : ACTIVITIES AND KNOWLEDGE / SKILL MIX OF DIFFERENT OCCUPATIONAL CATEGORIES

FIG. NO. 2



(2) CONVENTIONAL TYPE EXPERIMENT

Normally, for laboratory work it is the practice in almost all technical institutions to provide all the information to the student regarding the performance of each experiment in the laboratory or field. This information is either provided to the student verbally or by way of worksheet. The worksheet that is made available may have either complete or partially complete information of a particular experiment. Another way of imparting information to the student is, to give a laboratory manual at the beginning of the year or semester, related to the particular course. But, in most of the cases majority of the experiments are teacher-centred i.e. there isn't much scope for the student to think on his/her own, because the teacher has already done almost all the thinking for him/her.

This type of laboratory experiments we shall call as conventional type of laboratory experiment. We are calling it so, because this is the practice, which is normally being followed by convention/tradition.

In the conventional type of experiment complete set of instructions are given to the student to perform the experiment and carry out the calculations if any. No latitude from the line of action is suggested. These types of experiments could be more suitable in the beginning of the term or when the experiment is

complicated or when experiment is to be performed on a sophisticated equipment. Of course, this way of experimenting has its importance because, for developing certain type of skills like performing a standard test, this is the best strategy. But, will this strategy be able to develop all the intended skills that are required of a diploma passout when he/she enters the industry or any other enterprise ? If not, what are the other strategies ? One of the answers to this is the variety of experiments explained in the following paragraphs. Yes, the next question that may come up in your mind is, 'Will this type of experiments work within the frame work of the existing curriculum ?' Let this question be in your mind as we continue our discussion.

(3) PROJECT TYPE EXPERIMENT

The next type of laboratory experiment that is normally provided to the students is what we call as the **Project work.** This type is normally given in the last semester/year or (sometimes but very rarely) towards the end of the second year. In this case, we ask the student to choose any type of laboratory or field exercise he/she prefers and the student is free to do whatever he/she likes, with the approval of the teacher. The student is also given the freedom to report in a way, which most of the times is replica of their predecessors. Of course, this is totally a **student centred** exercise and as a teacher, this should be our ultimate goal regarding skills development in every technical student.

This type of experiment is intended to integrate the **knowledge, skills and attitude,** which the student should have acquired over the entire period of semester/year/ of a diploma or a degree programme. Depending on the time duration and the other resources available, this project may be called **a mini project or a just a project.** Now, what are some of the major components of a project ? You as a teacher will agree that, it should definitely have a **measurable and achievable outcome, a realistic time-frame, an action plan and persons identified for each activity.** The project work is envisaged because, this is the type of activity that a student will have to do when he/she will start working in the industry. Hence, **a project type of experience is really a necessity,** which also gives an indications whether the student has acquired the relevant skills.

Let us examine fig. 2 and compare a student with a new-born child, which does not know how to feed on its own but is continuously spoon-fed by its parents in the cradle (which we call conventional type experiment), will suddenly get up and start to walk on its own two feet independently, the very next day (which we call project type experiment). As a teacher what is your opinion ? Can we think that a student who was till yesterday familiar in performing experiments only when complete instructions are given, become **fully independent overnight ?** Just because the student has done one project, can he/she be able to perform confidently and successfully as soon as he/she enters the premises of the industry on his/her own.

(4) THE NEED FOR DIFFERENT TYPES OF EXPERIMENTS

An attempt has been made in this

paper to show how to bring about a smooth **transition** from a fully teacher-centred experiment (conventional type) to a fully student-centred experiment (project type), so that the skill of doing things independently is developed in the student gradually over a reasonable period of time. This is necessary because when the student arrives at the industry, he/she will have to solve problems and take decisions independently and work on his/her own with nobody to guide at each step.

The different categories of laboratory experiments that lie between the above mentioned two extremes can be named as follows (2) :

- **Conventional type experiment**
- **discovery type experiment**
- **investigation type experiment**
- **problem solving type and**
- **project type experiment**

(5) DISCOVERY TYPE EXPERIMENT

The discovery type experiment has to be so designed that the student is encouraged/guided to discover for himself certain facts, concepts, principles, laws, relationships etc., instead of directly telling them. This is an inductive method of instruction, giving the student the happiness of discovering something for himself/herself. This makes experimenting an interesting experience.

The salient feature of designing such an experiment is that interwoven questions should be built into the procedure which will facilitate thinking and lead the student to the discovery of the intended fact, concept or some standard relationship. Another feature is that, the procedure will be in greater detail, again taking care that discovery does takes place and that the 'cat is not out of the bag' earlier than envisaged.

This type of experimenting ensures that the student succeeds in applying his knowledge. It also helps in training him/her in taking a 'logical approach to a problem.'

(6) INVESTIGATIVE TYPE EXPERIMENT

This type of experiment is at a slightly higher level than the discovery type. The experiment is to be so designed that the decision-taking abilities of the student and the application of rules, concepts etc. should be more than that which occurs in the discovery type. This type utilizes various laws, rules, principles and the skills the student has already acquired. Hence, complete procedural instructions need not be provided - they can be partially structured and partially open-ended.

Some kind of directions/information are provided with regard to tools, equipments, materials etc. The students are free to think of alternative strategies, instruments and methods. He/she is required to plan his/her own experimental strategy, collect experimental data and draw conclusions. Thus, this will take the student more nearer to achieving problem solving skills. In this type teacher activity becomes lesser in comparison to the discovery type.

(7) PROBLEM SOLVING TYPE EXPERIMENT

Whenever a diploma or a degree passout gets employed or starts his/her own enterprise, at every moment of time, he/she will be facing small and big

problems which he/she will encounter in the form a problem statement - in short or in detail. The student will be on his/her own and there will be no one to tell him/her to perform this test or that test, nor will he/she be told which tools, apparatus to choose to solve a particular problem.

To help the student to tide over such above mentioned problem situation, presenting to him/her a few similar problem solving experiences in his/her own discipline will develop problem solving abilities and inculcate the confidence to face such situations before actually reaching the industry.

Once the 'problem statement/specification' is given in this type of experiment, the student is made to think, plan, generate alternative solutions, evaluate them and execute the best alternative. The student decides what data is to be collected, choose the requisite instruments/tools and decides how to carry out the method selected.

This type of problem solving experience is highly motivating and develops confidence and higher skills of planning and problem solving. For any particular course, the last one or two experiments need to be problem solving type. Try to present a new problem every semester/year.

(8) DEMONSTRATION

Laboratory demonstrations is a teacher-centred activity and is carried out when the equipment is costly, or the experimenting is a complex process, or some internal working is to be explained or it is dangerous to the man or machine. This is a totally teacher centred exercise in which the teacher will be demonstrating and the students will be observing the demonstration and responding to the questions raised by the demonstration during the conduction of the demonstration. After the demonstration the students will have to submit a report on the demonstration observed by them, a skill which is also to be developed.

(9) CONCLUSION

If the experiments are designed on the basis of our discussion so far, there will be enough scope for **laboratory innovations** that can easily be brought about by individual teacher thus making experimenting an interesting exercise for the teacher and the student alike.

BIBLIOGRAPHY

1. Adhikari T. B. - A Teachers' guide to Laboratory Methods on Electrical Technology; TTTI. Calcutta 1974.

2. Chandran G.S. - Designing of Laboratory Experiences; Monograph; TTTI, Bhopal; 1987.

3. Chandran G.S. - Design Laboratory Experiences; CBTE Module; TTTI, Bhopal.

4. C.P.S.C. - Aspects of Curriculum for Technician Education; CPSC, Singapore; 1982.

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