# IMPACT OF LABORATORY ACTIVITIES IN IMPROVING CONCEPTUAL UNDERSTANDING AND SKILL OF SENIOR SECONDARY STUDENTS

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**Abstract**

The word Lab or Laboratory in the minds of most people is synonymous with scientific investigation. If the laboratory is where scientists do their work, then it follows that much of science can best be learnt in the laboratory setting. The laboratory allows students to have experience that are consistent with the goal of scientific literacy. Laboratory activities are integral part of science teaching. Biology being the subject of living beings can be made lively and understood properly only with the help of practical experiments. Practical activity taking place in a Laboratory is not only associated with proper understanding of the subject but it has an important role in shaping the personality of a student. Laboratory activities when performed by the students gives a clear understanding of the theory already taught in the class. It develops skill and application ability among students. It develops a sense of responsibility, punctuality and grows team spirit. It makes the student more confident as his concept is clearer. It helps to grow workmanship in a student. A student performing practical experiments must be able to handle all the equipments utilized properly and systemically. The present study has been performed to assess whether the laboratory activity has developed conceptual understanding and laboratory skill among the students or not. Analysis of the result of the tests indicates there is certainly increase in the conceptual understanding in most of the practical activities. Although in some of the activities students didn't develop proper understanding. Regarding the development of laboratory skill it has been observed students have certainly developed skill. Although few basic skills like handling of microscope, staining methods and preparation of chemical solutions need to be improved more.

## Introduction

Although a goal of education is to develop student thinking abilities (Educational Commission, 1961; Holmes group, 1986; and National Science Board Commission, 1983), the emphasis of instruction appears to be on the transfer of knowledge (Bransford and Vye, 1989; Brown, Collins and Duguid, 1989). It has been observed by National Assessment of Educational Progress that teaching by science teachers does provide knowledge of scientific facts to the students, but fails to generate scientific thinking process among students (Mullis, Dossey, Foertch, Jones and Gentile, 1991). There are differences in opinion among researchers regarding how to develop thinking process among students, (Nickerson, 1988; Raths, Wasserman, Jones and Rothstein, 1986) but there is general agreement that to develop thinking process activity based teaching is required. Laboratory activities are integral part of a science curriculum. These give a clear insight about the lesson taught in theory classes. It is expected to initiate among students, the spirit of experimentation, keen observation and personal qualities as self-confidence, critical attitudes and perseverance. Laboratory activities should help the students to correlate with their theoretical knowledge and develop an analytical outlook to the problem. It should develop skill in handling laboratory equipments and team spirit among the students. Pickering (1980) identified two misconceptions about the use of the laboratory in college science. One is laboratories somehow "illustrate" lecture courses - a function that (in Pickering's opinion) is not possible in a simple, one-afternoon exercise. He contended that most scientific theories are based on a large number of very sophisticated experiments. He suggested that, if lecture topics are to be illustrated, this should be done through the use of audio-visual aids or demonstrations. The second misconception is that laboratories exist to teach manipulative skills. Pickering argued that the majority of students in science laboratory classes do not have a career goal of becoming a professional scientist. Further, many of the skills students learn in laboratories are obsolete in science careers. If these skills are worth teaching, it is as tools to be mastered for basic scientific inquiry and not as ends in themselves.

Shulman and Tamir (1973), in the Second Handbook of Research on Teaching (Travers, ed., 1973), listed five groups of objectives that may be achieved through the use of the laboratory in science classes:

1. Skills - manipulative, inquiry, investigative, organizational, communicative

2. Concepts - for example, hypothesis, theoretical model, taxonomic category

3. Cognitive abilities - critical thinking, problem solving, application, analysis, synthesis

4. Understanding the nature of science - scientific enterprise, scientists and how they work, existence of a multiplicity of scientific methods, interrelationships between science and technology and among the various disciplines of science

5.Attitudes - for example, curiosity, interest, risk taking, objectivity, precision, confidence, perseverance, satisfaction, responsibility, consensus, collaboration, and liking science.

Laboratory activities have long been regarded as a means to improve understanding, skill development and thinking process among students. If proper instruction is provided practical activities may develop confidence among them. But the type & standard of practical activity influences the thinking process of the students. Too easy practical activities do not inculcate much meaningful thinking. Too difficult or lengthy laboratory activities result in loss of interest among students. Objectives of teaching Biology practical are:

- ?to enable students to appreciate the scientific method which involves experimentation,
- ?to develop accurate observation, recording, deduction and interpretation of scientific data
- ? to enable students to develop laboratory skills
- to develop conceptual understanding of the subjects

**Objective**

The study is aimed to find out whether laboratory activities, the essence of science curriculum are developing aforesaid qualities in students. If the answer is no, then what are the problems?

**Research Questions**

1. Whether performance of laboratory activities has really improved conceptual understanding in senior secondary students?
2. Whether after performing biology practical activities students have truly developed skill in handling laboratory equipments or not.
3. What are the factors perceived by the Biology teachers to hinder effective learning in senior secondary school practical?

**Methodology**

A survey design was adopted for the study. It involves the collection of data on students' perception of biology practical activities using appropriate questionnaires. The respondents are to indicate their agreement or disagreement on a 3-point scale of agree, disagree and not sure. There are 4 sets of questionnaires; 2 sets for judging conceptual understanding and 2 sets for assessing skill development in XI and XII class students. Two sets of questionnaires based on conceptual understanding were on a three point scale (agree, do not agree, not sure). Two sets of questionnaire on skill development consist of multiple choice questions. Rest two questionnaires consist of open ended questions.

Two different research instruments were used for the study.(i) Students of Class XI and XII were asked to answer closed end questionnaire 1 and 2 respectively by ticking in one of the boxes labeled 'agree', 'disagree' and 'not sure'. (ii) Questionnaire 3 consists of fifteen MCQ questions, each with four possible answers. Students of class XI were expected to tick in any one of the answer. Questionnaire 4 is again of closed end type on 3 point scale. It consists of ten questions. Students of XII class were asked to tick in any one of the boxes labeled 'Agree', 'Disagree' and 'Not Sure'. The questions in the Closed Ended and Multiple Choice type and were grouped under two categories:

(i) Conceptual understanding

(ii) Skill development

**Analysis**

**A. Response to closed form questionnaire**

The test had been conducted for 198 students (91 male and107 female) from 6 different schools. The number of closed ended questionnaire sets is two. Set 1 and 2 consists of 10 and 15 questions and is for class XI and XII respectively.

In the experiment of Salivary Amylase, majority of students (83%) agreed that salivary amylase activity increases with the increase of temperature, whereas only 15 percent of students disagreed to the statement. Majority of the students (50%) believed that during photosynthesis, the source of evolved $O_2$ is not $CO_2$. 8 percent was not sure about the answer. Likewise, 87 percent agreed that the zoological name of liver fluke is *Fasciola hepatica*. Only 10 percent disagreed to the statement. 3 percent was not sure about the answer. Surprisingly, a large number of students (67%) believed that deplasmolysis takes place due to moving out of solutes from the cells.

In the activity of observing permanent prepared slides, majority of students (80%) agreed that mature sperms are found near periphery of seminiferous tubules, which is not correct. Majority of the students (60%) express their ignorance regarding the presence of aster in the plant cell. 18 percent of them disagreed that astral mitosis occurs in plant cell, where as 32 percent agreed that plant cells exhibit astral mitosis. 92 percent students believed the nature of hereditary disease can be known by pedigree chart. In the activity of pollen germination, most of the students have good understanding and clear concept. Regarding morphological experiment, 30 percent of the students has less understanding in the inflorescence and confuse 'cyathium' with 'cymose'.

**B**. Response to questionnaire to assess development of laboratory skill among students

The test had been conducted for 198 students (91 male and107 female) from 6 different schools. The number of closed ended questionnaire sets is two. Set 3 and 4 consists of 15 and 10 questions and is for class XI and XII respectively.

Regarding development of skill, students have been found to develop skill (76%) in the physiological experiment of action of salivary amylase on starch, but in the experiment of deplasmolysis many students (44%) have an idea that either drop of saturated solution has to be poured directly on the sample or it has to be kept dipped in the solution.. But regarding handling of microscope, students have poor skill. In the anatomy slide preparation proper technique has not been followed by a large number (34%) of the students.

Regarding development of skill in laboratory activities among students of class XII most of the students (62%) has developed proper technique in staining and squashing, but in selection of proper sample and collection of sample at specific time has not been understood by them. Surprisingly many of them (20%) believed that aestivation can be best understood in open flowers. About measuring solution in measuring cylinder, 91 percent of students had correct idea that while measuring the solution always lower meniscus should be observed. 7 percent of students did not agree this statement and only 2 percent was not sure about it. Students express almost equal response, i.e. 48 percent and 46 percent agree and disagree to the statement that" phylloclade and peepal leaves are analogous organs". Only 6 percent exhibit their ignorance.

## Discussion

Biology teaching remains incomplete in absence of laboratory activities. The latter is essence of not only Biology but Science teaching. Laboratory activities not only strengthen knowledge, but also increase conceptual understanding and develop skill in laboratory performances. Pickering (1980) identified two misconceptions about the use of the laboratory in college science. One is that laboratories somehow "illustrate" lecture courses - a function that (in Pickering's opinion) is not possible in a simple, one-afternoon exercise. Pickering contended that most scientific theories are based on a large number of very sophisticated experiments. He suggested that, if lecture topics are to be illustrated, this should be done through the use of audio-visual aids or demonstrations. The second misconception is that laboratories exist to teach manipulative skills. Pickering argued that the majority of students in science laboratory classes do not have a career goal of becoming a professional scientist. Further, many of the skills students learn in laboratories are obsolete in science careers. If these skills are worth teaching, it is as tools to be mastered for basic scientific inquiry and not as ends in themselves. Positive research findings on the role of the laboratory in science teaching do exist. Laboratory activities appear to be helpful for students rated as medium to low in achievement on pretest measures (Boghai, 1979; Grozier, 1969). Godomsky (1971) reported that laboratory instruction increased students' problem-solving ability in physical chemistry and that the laboratory could be a valuable instructional

technique in chemistry if experiments were genuine problems without explicit directions. Working with older, disadvantaged students in a laboratory setting, researchers (McKinnon, 1976; McDermott et al., 1980) used activities designed to create disequilibrium in order to encourage cognitive development. This study has revealed that students have developed conceptual understanding in most of the activities. In some activities like finding similarities between two parts of plants and determining whether they are homologous or analogous organs, or ignorance in finding out whether a given cytological slide is of plant or animal material.

## Conclusion

Based on the result of the study it is concluded that laboratory activities indeed increases conceptual understanding and skill development in some of the areas, but they were not able to give hundred percent improvement in all the activities. The reason may lie in incorrect acceptance of knowledge, lack of enthusiasm of the student, insufficient theoretical knowledge, lack of orderly and systematic conduct of the activity etc.

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