



## CHEMISTRY LABORATORY COMPETENCE AND ACADEMIC ACHIEVEMENT IN CHEMISTRY AMONG HIGHER SECONDARY SCHOOL STUDENTS

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### Abstract

Normative survey was adopted for the study with a sample of 300 higher secondary school students. The standardized chemistry laboratory competence test developed by the Dr.(Mrs.) Meena Buddhisagar Rathod and Ms. Renu Moyade kotwale (1971) was used to assess the level of the higher secondary school students. The collected data were analyzed qualitatively and quantitatively to check the significant mean difference among the variables. The result revealed that the chemistry laboratory competence level and academic achievement in chemistry of the higher secondary school students was average. It was concluded that the chemistry laboratory competence level and academic achievement in chemistry of the higher secondary school students was at the average level. It is recommended that the chemistry laboratory competence level of the higher secondary school students should be improved through their teaching - learning process.



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## INTRODUCTION

Laboratory work is essential in the study of science (chemistry). A chemistry laboratory is a workshop for chemists. Here students learn the techniques of the preparation, identification and estimation of chemical substances. The primary goals of introductory laboratories have been evolving over the past century. The current impetus for changes in laboratory instructions stem from new research on students' learning and technology, as well as changes in overall goals of instructors.

### ***School science laboratory***

A school science laboratory is a place where basic experimental skills are learnt by systematically performing a set of prescribed and suitably designed experiments. Performing experiments by one's own hands is not only a thrilling experience but is also important because it entails learning by doing. It also facilitates understanding the concepts of science. The experiments and project work suggested at the secondary stage intend to develop basic skills of measurement; handling of some common measuring instruments, equipment and chemicals; setting simple apparatus; handling microscope and preparing slides; making observations; collecting data and presenting it in appropriate format; interpreting and drawing conclusions; and preparation of report. There are certain rules and regulations that every student must be familiar with before undertaking practical work in a laboratory. A student is required to be acquainted with the general facilities and the equipment available in the laboratory and follow the rules and regulations. Generally, In the beginning of the session, the teacher takes the students around. ***Chemistry laboratory***

Students learn the techniques of the preparation, identification and estimation of chemical substances. Before starting an experiment, a student must know from where to get the apparatus required for the given experiment and the placement of the chemicals to be used. A student must know the proper use of each equipment and the precautions to be observed while working in the laboratory. A chemistry laboratory is provided with the following fittings with which the student must become familiar.

### ***Chemistry laboratory competence and Academic achievement in chemistry***

Ability to apply chemistry knowledge and understanding to the solution of qualitative and quantitative problems of an unfamiliar nature. Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems.

For science students the Laboratory is a place for skills for accomplishing and performing experiments. Experiments are meant to learn the scientific procedure. Students learn skills one by one to become competent scientists, pharmacists, laboratory technicians and many professionals.

Competence words have an element of skill rather than information. It implies the ability to do something. Competence development needs different types of activities to be practiced a sufficient number of times. Instructional objectives in the classroom are usually impactful in terms of cognitive and affective development but also focus on overt implication in the form of skill development. Science requires manipulative skills. Webster's new

dictionary skill is" the ability to use one's knowledge effectively and readily in execution or performance, technical expertise, a power or habit of doing any particular thing competently". Few research studies conducted in the area of laboratory performing skills reveal the laboratory performances of a science student help in content learning. Chemistry is an abstract science. Laboratory workers are needed to explain and present, illustrate the cause and effect of certain abstract chemical principles and theories.

Science education plays a critical role as political priority due to its fundamental importance in engaging students to pursue technological careers considered essential in modern societies, in order to face scientific development challenges. High-level achievement on science education and positive attitudes toward science constitutes a crucial challenge for formal education. Several studies indicate close relationships between students' attitudes, cognitive abilities, and academic achievement.

### **SIGNIFICANCE OF THE STUDY**

The significance of the study is to develop knowledge and awareness among the students about handling the apparatus, knowing the effects and defects of the chemical components, provide experience to acquire skills and help students to achieve their academics also.

### **METHOD OF THE STUDY**

Normative survey method was adapted to study the chemistry laboratory competence level of the 300 (100 students from each Government, Government-aided and Private school) higher secondary school students. The chemistry laboratory competence test (CLCT) was used to study the chemistry laboratory competence level of the higher secondary school students. The background variables namely gender and quarterly examination marks are also taken in order to find out the influence of these variables on chemistry laboratory competence of the higher secondary school students.

### **OBJECTIVES OF THE STUDY**

- To study the level of chemistry laboratory competence and academic achievement in chemistry among higher secondary school students.
- To study the difference in chemistry laboratory competence and academic achievement in chemistry among Government, Government-aided and Private schools of higher secondary students.

- To find out the significant difference if any of the higher secondary school students in the chemistry laboratory competence and academic achievement in chemistry based on gender.

### **HYPOTHESES OF THE STUDY**

1. There is no significant relationship between chemistry laboratory competence and academic achievement in chemistry.
2. There is no significant difference between male and female students in chemistry laboratory competence test.
3. There is no significant difference between male and female students in academic achievement in chemistry.
4. There is no significant difference in chemistry laboratory competence of higher secondary school students based on the types of school.
5. There is no significant difference in academic achievement in chemistry of higher secondary school students based on the types of school.

### **SAMPLING PROCEDURE**

The random sampling method was used by the investigator for the present study. The population of the study consists of higher secondary school students from Government, Government-aided and private schools. In which 100 students are from Government schools, 100 students are from government aided schools, 100 students are from private schools in Chennai, Tamil Nadu. In total 300 the selected for the sample from 6 different schools.

### **TOOLS AND TECHNIQUES**

The investigator used the standardized tool to find out the chemistry laboratory competency developed by *Dr.(Mrs.) Meena Buddhisagar Rathod and Ms. Renu Moyade kotwale (1971)*.

### **DESCRIPTION OF THE TOOL**

The Chemistry laboratory competence test CLCT is a performance test to assess laboratory competence. It is meant to measure laboratory competence for the secondary and higher secondary school students. The test consists of 27 items. This includes six sub-sections consisting of alternative type, match the column, one word answer, fill in the blanks and short answer type questions.

The basis of item selection was experimental skill classification, measurement, following correct laboratory procedures, Analyzing situation, Selecting hypothesis, Handling instruments, Implying safety rules and Problem solving. Keeping in mind, the above facts

present that the test has been prepared with the hope that it may facilitate to measure laboratory competence.

SECTION-A

Measure the skill of handling apparatus in the Chemistry laboratory. It represent the students ability of abstraction, discrimination and also measure cognitive ability to perform correctly, the laboratory procedure by handling apparatus safely and in the appropriate manner.

SECTION-B

Measure the skill of Investigation. It represented the students ability of observation, in perceiving cause and effect relationship in chemistry experiments under different conditions. This became the basis of processing and retrieval of information at the abstract level.

SECTION-C

Measure the skill of drawing inference and reporting results. It represents the students ability of hypothesizing and drawing the best solution through a previous experimental learning. This became the bioses of systematic writing of results.

SECTION-D

Measure the skills of computation and measurement. It represents the students ability of mathematical calculation, to observe the authentic procedure for reporting reading of commonly used laboratory procedures. This ascertains accuracy in observation and thus in results too.

SECTION-E

The skill of using and differentiating commonly used laboratory apparatus. It represents the ability of students' awareness about its apparatus and use in different required laboratory procedures.

SECTION-F

Show the skill of using safety measures while performing laboratory work. It represents the ability of a student's awareness about safety measures and precautions to be followed in the Chemistry laboratory.

The questions are framed in simple English, according to the level of sample students and easy scientific terms to enable the testis to answer them. This test is helpful in judging and individual performance in a Chemistry laboratory.

The investigator administered the test to the sample of 300 higher secondary school students after getting prior permission from the concerned Head of the institution. The school students were requested to give their free and honest response to the test items.

## STATISTICAL TECHNIQUES USED

The collected data were analyzed qualitatively and quantitatively to fulfill the objectives of the study. The investigator used descriptive and differential analysis as a statistical technique for the present study.

## ANALYSIS AND INTERPRETATION

**HYPOTHESIS 1-** There is no significant relationship between chemistry laboratory competence and academic achievement in chemistry.

**Table -1: Table showing the relationship between chemistry laboratory competency and academic achievement in chemistry**

Variables	Chemistry laboratory competence	Academic achievement in chemistry
Chemistry laboratory competence	1	.028
Academic achievement in chemistry	.028	1

The calculated r value in the above table shows there is no significant difference and negative difference between chemistry laboratory competence and academic achievement in chemistry.

**HYPOTHESIS 2-** There is no significant difference between male and female students in chemistry laboratory competence test.

**Table -2: Table showing the difference between male and female students in the chemistry laboratory competency test**

Chemistry laboratory competency	Gender	N	Mean	Standard deviation	Standard error mean	t value	Level of Significance
Section A	Male	152	11.5066	.97652	.07921	1.09	NS
	Female	148	11.3851	.94418	.07761		
Section B	Male	152	6.2829	.68492	.05555	1.20	NS
	Female	148	6.1824	.75626	.06216		
Section C	Male	152	9.0263	.74538	.06046	.843	NS
	Female	148	8.9527	.76784	.06218		
Section D	Male	152	10.5987	.90809	.07366	.224	NS
	Female	148	10.6216	.86035	.07072		

Section E	Male	152	20.5461	.97545	.07912	.878	NS
	Female	148	20.4459	.99853	.08208		
Section F	Male	152	5.4868	.50148	.04068	1.04	NS
	Female	148	5.5473	.49945	.04105		
Total	Male	152	63.2566	2.76568	.22433	.955	NS
	Female	148	62.9730	2.35301	.19342		

\*NS- No significance

It is inferred from the above table value that there is no significant difference between male and female students in chemistry laboratory competence test.

**HYPOTHESIS -3** There is no significant difference between male and female students in academic achievement in chemistry.

**Table -3: Table showing the difference between male and female students in the academic achievement in chemistry.**

Academic achievement in chemistry	Gender	N	Mean	Standard deviations	Standard error mean	t value	Level of Significance
	Male	152	1.2958	38.69348	3.13846	.890	NS
	Female	148	1.2560	38.72294	3.18301		

\*NS- No significance

It is inferred from the above table value that there is no significant difference between male and female students in academic achievement in chemistry.

**HYPOTHESIS -4** There is no significant difference in chemistry laboratory competence test of higher secondary school students based on the types of schools.

**Table -4: Table showing the difference among students in chemistry laboratory competence based on types of schools.**

		Sum of squares	Difference	Mean square	F	Significance
Chemistry laboratory competence	Between Groups	.375	2	.173	.314	NS
	Within Groups	164.040	297	.552		
	Total	164.387	299			

\*NS- No significance

It is inferred from the calculated 'F' value that there is no significant difference in chemistry laboratory competence test of higher secondary school students based on the types of schools.

**HYPOTHESIS -5** There is no significant difference in academic achievement in chemistry of higher secondary school students based on the types of school.

**Table -5: Table Showing the difference among students in academic achievement in chemistry based on types of schools.**

		Sum of squares	Difference	Mean square	F	Significance
Academic achievement in chemistry	Between Groups		297	.503	.723	NS
	Within Groups	1.001	299	.696		
	Total	206.740				
		207.747				

*\*NS- No significance*

It is inferred from the calculated 'F' value that there is no significant difference in academic achievement in chemistry of higher secondary school students based on the types of schools.

## FINDINGS

- The level of chemistry laboratory competency and academic achievement in chemistry of higher secondary school students is average.
- There is no significant difference with reference to gender and type of schools in chemistry laboratory competency and academic achievement of higher secondary school students.

## CONCLUSION

It is imperative for schools to have the latest and high quality science lab supplies these days. Science is different from any other subject. In order to understand its concepts, one has to look beyond the books and conventional classroom teaching. Effective teaching and learning of science involves seeing, handling, and manipulating real objects and materials. The knowledge that kids attain in classrooms would be ineffectual unless they actually observe the process and understand the relationship between action and reaction. Effective teaching and learning of science involves a perpetual state of show and tell. Good schools combine classroom teaching with laboratory experiments to ensure that their students grasp each and every concept thoroughly. It is also believed that laboratory teaching and experiments that are



being conducted there help encourage deep understanding in children. Children are able to retain the knowledge for longer when they see the experiments being performed in front of their eyes.

Science lab equipment allows students to interact directly with the data gathered. They get a first-hand learning experience by performing various experiments on their own. Students are made to use the models and understand different scientific theories and concepts. It is also found that school science lab equipment and supplies make teaching and learning easy both for the teachers, as well as for the students. There are several scientific theories and concepts that are difficult to explain directly from the books. Anatomy models, physics science kits, and chemistry science kits for instance make it easy to understand the otherwise complex theories of science.

By virtue of equipping themselves with the latest and the advanced materials and supplies, schools are able to contribute a lot in the scientific advances yet to come. The advances and developments in the field of medical science and technology would not take place if schools did not prepare brilliant and dedicated scientists and researchers. Children develop interest in scientific research in science labs. When they observe various things and carry out different experiments, their reasoning skills are honed and they start thinking deeply on those theories and concepts. Schools thus play a vital role in bringing up the next generation of engineers and doctors.

To conclude, schools must have the latest science lab supplies and equipment to make science interesting and effective for students and to encourage them to make significant contributions in the field of physics, biology, chemistry, and other streams of science later in life.,

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