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Innovative Laboratory Teaching

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Preamble: This Paper is excerpts from a Research Paper (Un-published), read and presented by the author during a Seminar-cum Workshop held in Pune, Maharashtra, India during 4th and 6th January 1984 and hence it becomes inevitable and necessary to first of all introduce to the readers institutions and few individuals concerned with the proceedings.

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7	Prof. Mahashabde	Expert	TTTI Extension Center, Pune, India
8	Prof. A.M. Wadhwani	Participant from Mech. Engg..Dept	#Victoria Jubilee Technical Institute (VJTI), Mumbai
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*Now known as National Institute of Technical Teachers Training and Research Institute (NITTTRI)
Now known as VeramataJeejabhai Technical Institute (VJTI)
@Initials of some of the participants do not appear as the same is not recorded by author

Abstract
This Paper forms the minutes of the proceedings from a Seminar-cum Workshop held in Pune during 4th and 6th January 1984 when the author read and presented a paper which as on today is not published. The presentation is such that the reader himself will feel or rather should assume himself to be a participant. From this point of view, this research paper deviates from the standard format of research methodology which all readers to kindly note. There is an introductory talk by the author followed by presentation of the paper. The focus of the subject is on Physics. Both Conventional Experiments and Demonstration Experiments are extensively discussed with the teaching scheme and examination scheme.

Key Words
Assessment, Conventional Experiment, Demonstration Experiment, Evaluation, Term Work

I. Introduction

There was no task group leader representation from our Polytechnic as the area of laboratory innovation is not included in the Institutional Plan of our Polytechnic. The point that S.B.M. Polytechnic is much advanced in the area of Laboratory Innovation was mentioned by Prof. Haidar of TTTI Bhopal. The session of reading the paper was there on 6th January 1984. I took opportunity of reading my paper submitted earlier to all participants and before

doing that the staff members from my institute were of the opinion that as a senior staff member I should represent our institute. This I did in a generalized way by recalling and recollecting certain points spoken earlier by UK consultants Prof. Topple, Dr.(Mrs.) Doueck and Prof. Hardikar of Cusrow Wadia Institute of Technology (CWIT), Pune. The dais had the following arrangement:
Chairman:- Prof. Hardikar of CWIT
Presiding Staff:- UK Consultants Dr.(Mrs.) Doueck and Prof. Topple
Recording Staff Member:- Prof. A.M. Wadhwani of VJTI
Date and Duration:- 4th January 1984, 12.25 PM to 1.10 PM
Honorable UK consultants, Dr.(Mrs.) Doueck and Prof. Topple, Chairman Prof. Hardikar, TTTI Experts and dear participants:
Before I will be presenting my Paper on tomorrow, I would like to give a preliminary talk about our institute and also express my views on the basis of today's morning session.
I am Mr. V.C.A. Nair. Lecturer and In-Charge Physics Section from Shri Bhagubhai Mafatlal Polytechnic, Mumbai. Our Polytechnic needs no introduction. Next only to VJTI, ours is the first institute to gain autonomy and academic freedom in the whole of Maharashtra State. This is well known to all of you. I am a task group member in the area of Assessment and Evaluation, the task group leader of which is Prof. A.C. Mehta, who is the Dean, Administration.
In our Institutional Plan, we have different areas such as Curriculum Development, Assessment and Evaluation and Informative Systems.. The area of Laboratory Innovation , however, is not included in our Institutional Plan probably because, as mentioned earlier by Prof. Haidar that we are much advanced in that field. I take this opportunity to thank Prof Haidar for that compliment on behalf of our Polytechnic.
Before I take up my paper, I would like to recall certain points mentioned by Dr. Doueck and Prof. Topple in the earlier session. The 'PROBLEM' and its 'SOLUTION' were two of the many points mentioned by Dr.Douck. According to me, correct and appropriate solutions to problems are really the innovations in the field of laboratory teaching. She also mentioned various aspects such as students,
Teachers, UK Consultants, TTTI employees, examining board and many others. Among all these, two basic and major aspects that are involved in our present laboratory innovation, according to me, are the TEACHER and the STUDENT. To emphasize the same, these two words were written on the blackboard and I continued. I would now like to ask a question: Out of these the Teacher and the Student, which one is primary? Before answering this question, I would like to recall the aspect of "Cause" and "Effect" under skills training mentioned by Prof. Topple. As an answer to my question, I would like to correlate some of the concepts of Physics with our present discussion. There is a "Cause and Effect" formalism in Physics and according to Newton's third law, forces always exist in pairs. You can now correlate PROBLEM and SOLUTION. Problem is the Cause and Solution is the Effect. Teacher and Student are similarly action-reaction pairs. If Action is primary and the basic cause for reaction which is secondary and the effect, well then, according to me, Teacher is primary and Student secondary. What I mean by this is that the teacher is basically responsible for any innovation to be done in the field of his subject and the student is only a responsive element. You cannot expect an innovation in any academic sphere to be done by students.
I shall now come to one of the key words used by Prof. Topple in his talk. The very first key word used by him was"INTEREST". Looking at Prof.Topple, I said. I would like to add some adjectives to this word Interest. It should be rigorous interest, vigorous interest and spontaneous interest. At this juncture, a participant from the audience said: Add one more 'Long lasting interest'. It is the interest of the teacher that counts in any innovation. Prof. Bongale from Fr.Agnel Technical Institute had remarked earlier that in his institution extra remuneration is paid to staff who put in extra work. I agreed with him and said that from the point of view of innovation in curriculum, we do not correlate money with work and such a thing should be done on a separate table. If we compare our state of affairs with our brethren in industry, we land in frustration.
Our chairman, Prof. Hardikar in his first paper reading today mentioned in his introductory talk regarding support between technical and non-technical staff. Looking at Prof. Hardikar, I said: I am a man of Science which at present is taken as non-technical and reiterated that "Science involves more techniques than itself remaining non-technical in a Polytechnic curriculum" I think this aspect of non-technicality is not known to the UK Consultants.
We have innovations done in all laboratories such as Physics, Chemistry. Applied Mechanics, Heat Engines, Plastics Testing and so on. Members from these laboratories are attending this program. The type of innovation done slightly varies in different subjects because subjects like Physics and Chemistry have both Term Work and Practical examination whereas a subject like Applied Mechanics has only Term Work. I shall present here the innovation done in the Physics Laboratory Teaching which is progressively applied to other subjects as well.

II. Review of Literature

As such there is no literature survey except referring to and suitably modifying
Engineering Experimentation Course by TTTI, Bhopal.
The presentation of the paper was carried out on 6th January 1984 with the following staff on the dais:
Chairman: Dr.(Mrs.) Doueck
Presiding staff member: Prof. Haidar
Recording staff member: Prof. Mahasabde
Date and duration: 6th January 1984, 12.15 onwards
Honorable UK Consultants, TTTI Experts and dear participants,

We have adopted with modification the Engineering Experimentation Course as per TTTI Bhopal right from the year 1979.
At every stage of this process we feel we have acquired our targets. I would like to present here the process of laboratory experimentation that is carried out in the Physics Laboratory of Shri Bhagubhai Mafatlal Polytechnic. Whether it is really an innovation or otherwise or what changes are to be brought about from the point of view of others, it is left to the UK Consultants, TTTI Experts and other participants present here to make suggestions.

1. Introduction

Scientific developments have taken place in laboratories. Laboratory is a part and parcel of any scientific or technological institution. As you know, reality of any scientific theory is nothing but an experiment. Experiments are performed in laboratories. Like the word, "Engineer", the word, "Experiment" is both a verb and noun. One, in fact, should not carry out experiments in order to just experiment a particular scheme. The scheme should bring out best results and the scheme should be acceptable to both the teacher and the taught. The experiments must be application

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oriented specially for a polytechnic curriculum.

The question is "How the practical work is carried out in a laboratory?" Do you straight away tell the students, "Perform the experiment and carry out the work" Experimentation is a process by which a number of experiments are carried out in different ways. During a practical session experiments may be carried out in three different ways. They are:

- By actual performance,
- By Demonstration and
- By self study.

The first two are standard methods and will be discussed here. The last one, i.e By self study (wherein the student independently studies an experiment by means of charts, instruction manual, etc. without the help of the teacher) will not be discussed here as such a method is usually not followedanywhere.

2. Engineering Experimentation Course as per TTTI Bhopal

As I mentioned earlier, Physics and Chemistry Laboratories of our Polytechnic have adoipted the Engineering Experimentation Course of the TTTI Bhopal right from the year 1979 with modifications to suit our curriculum. The summary of the course is given to the students during the first two or three periods of the semester. The factors emphasized are:

- Introduction and course philosophy. This includes aims of the course and aims of laboratory work
- A series of lectures (1 to 6)

Lecture No.1: Experimental work in Engineering Diploma Course – How? and Why? The point stressed in this lecture is that the polytechnic student is going to be neither a craftsman nor an engineer, but a "Technician Engineer" – a man for the job. This lecture also includes some brief introduction of semester-I and semester-II experiments including demonstration experiments.

Lecture No.2 Experimental results – Appraising and Recording. This includes importance of recording, errors and their elimination, use of audio-visual aids, OHP, Projector, etc.

Lecture No.3. How to carry out an experiment with a sample experiment? The various points stressed in this lecture are: Working in groups, Discussion, Maintenance of rough records (log book), charts and journals, completion of work, etc.

Lecture No.4. Measurement of physical quantities and units (This is completely omitted as the same is included in the theory).

Lecture No.5. A Review of the New Engineering Experimentation Course and introduction to experiments of second semester. This is done at the end of the first semester with due stress on the review of aims.

Lecture No.6. Report Writing. Write-up of the experiment in a fair journal in a specified manner with due stress on continued assessment and timely submission.

3. Eaxperiment by Performance

This method varies at different places and is also different for different subjects. Where there is only Term Work and no examination as in the case of Applied Mechanics, for example, emphasis is more on the study by observation and report writing. Subjects in which there is Term Work as well as practical examination as in the case of subjects like Physics and Chemistry, apart from all other essential aspects, the experiment is conducted from an examination point of view. The method followed in the Physics Laboratory of our Polytechnic is as under:

Before performance of the experiments by the students, they are provided with instructional charts regarding the Aim, Apparatus supplied, formula to be used, observation table, graphs, etc. of the experiment. Students copy down the charts quickly. (To avoid waste of time in this process of copying, the charts may be supplied earlier so that the students come duly prepared). There is group working as mentioned in the Engineering Experimentation Course. A group of 10 or 12 (maximum) students under the guidance of one teacher works on 5 or 6 copies of the same experiment. The number of copies of the experiment depends upon the availability of the apparatus for that experiment. The experiment is fully explained by the teacher and the students perform the experiment, take observations, enter readings in a rough journal. At the end of the session, the students take signature of the teacher concerned on their rough journal (log book). On showing these rough journals with the signature of the teacher, the laboratory assistant records the attendance of the students. To have a counter check during assessment, the log books are to be submitted along with the fair journals at the time of submission of Term Work.

4. Experiment by Demonstration

Pilosophy: "*The Work of Science is to substitute facts for appearances and Demonstratioins for impressions"*

5. Introduction

In the usual case of an experiment arranged for a demonstration, the teacher explains and shows the experiment to a group of say, 10 students. One demonstration experiment may be followed by another or many depending upon the availability of time and the extend up to which the apparatus works. This method is certainly defective as there is no proper student-teacher interaction pertaining to any experiment demonstrated mainly because of the fact there is no testing method existing on demonstration experiments. Due to this a majority of students *just see* a demonstration experiment without bothering into the details of the same. Even though the phrase, "*Seeing is believing"* is to be believed to a certain extent, in the present context of dealing with a demonstration experiment the phrase is to be modified to: *Seeing is believing and understanding is satisfaction"* The points of understanding and satisfaction are done by a test.

I am giving below details of the scheme of demonstration experiments adopted in the Physics Laboratory of SBM Polytechnic since 1979.

6. <u>The Scheme</u>

The scheme is classified into the following:

1. Planning and preparation
2. Write-up of the demonstration experiment.
3. Detailed explanation by the teacher.
4. Actual demonstration of the experiment by the teacher.
5. Student-Teacher Interaction.
6. Discussion among the team.
7. Self-thinking and collection of additional material from the library.
8. Write-up of the complete experiment in the fair Journal and
9. Practical examination on demonstration experiments.

The various points mentioned in the above scheme are further explained in the following:

1. Planning and poreparation: The number of experiments (usually 2 or 3) for demonstration are chosen in such a way that each experiment is a lengthy experiment when

performed as a conventional experiment in the laboratory. Such lengthy experiments are grouped together and planned as a set of demonstration experiment. As for the preparation, a set of charts containing the theory, experimental set-up and procedure regarding the experiment is prepared and the experiment is set up on a laboratory table preferably near a black board.

2. Write-up of the demonstration experiment: A team of students for the demonstration experiment as they come just take down in their log boos the material from the charts. While writing the student is supposed to go through what he is writing. Roughly half or at least one-third of the total time is spent by the student in this writing work.
3. Detailed Explanation by the Teacher: The teacher then takes the team of students to the working table where the experiments are arranged and explain with relevant theory the details of the experimental set-up with the help of black board, duster and chalk or any other audi-visual aid.
4. Actual demonstration of the experiment by the teacher:The experiment, from the point of view its working, is actually shown to the students by the teacher. If it is the case of, say, seeing a spectrum or seeing something through a microscope or telescope, it is actually shown to each individual student. Every student is instructed to think deeply regarding some difficulty or doubt which they might encounter during this demonstration and thereby correlate the written material with what he has seen.
5. Student-Teacher Interaction: This is a discussion between the teacher and the students. The various doubts and difficulties of the students are solved during this discussion. Solving the difficulties and clearing the doubts will further enlighten the gain of knowledge regarding that experiment. It is made compulsory that each student should necessarily ask at least something pertaining to that experiment.
6. Discussion among the team: After the interaction between the teacher and the students, the team of students is allowed to discuss among themselves regarding the experiment after which the teacher further attends to the queries, if any, from the team.
7. Self-thinking and collection of material from the library: The students are then asked to collect from library at their leisure additional information regarding the set of demonstration experiments and add to what they have written down from the charts supplied in the laboratory.
8. Write-up of the complete experiment in the fair journal: The status given to a demonstration experiment is the same as that given to a conventional experiment which is actually performed in the laboratory except that the student has not physically performed the experiument, all other things remain the same and the experiment is written in the journal as usual. A demonstration experiment or a set of demonstration experiments is counted at par with other experiments at the end of the semester for the purpose of certification of the journal.
9. Practical examination on demonstration experiments: There is a practical examination on demonstration experiments along with practical examination of other conventional experiments. As there is an examination, the various items of the scheme are well stressed. Along with many conventional experiments kept for examination, usually one demonstration experiment or a set of demonstration experiments is coupled with a conventional experiment in such a way that the duration to complete the conventional experiment is less than two-third of the total time. During the remaining one-third of the time the student attends to the demonstration experiment. The allocation of marks is roughly two-third of the total marks for the conventional experiment and one-third for the demonstration experiment. In the following is given a typical question set for a practical examination

(A) FIND THE LEAST COUNT OF THE GIVEN TRAVELLING MICROSCOPE AND MEASURE THE INNER AND OUTER DIAMETERS OF THE RUBBER TUBE. TAKE AT LEAST TWO OBSERVATIONS FOR EACH DIAMETER.

Marks: 35 Time Allowed: 1Hr.45 Min.

(B) DEMONSTRATION EXPERIMENTS

The following experiments are arranged and set up.

1. Newton's Rings
2. Grating Spectrum of Sodium
3. Polarimeter
4. Poiseuille's apparatus for viscosity

You are hereby asked with relevant theory the complete experimental set-up any twoof the above with answers to the questions put to you by the examiners.

Marks: 15 Time Allowed: 15 Min.

III. Mode Of Examination For Demonstration Experiments

A. Introduction

The student is taken by the examiners (both internal and external) to the table where the demonstration experiments are arranged and he is simply asked to explain whatever he knows regarding the experimental set up to both the internal and external examiners who individually or jointly ask questions to the student regarding that experiment. Answers given correctly to 60 to 75 per cent of the questions put to him is taken as a good credit and the marks are assigned to that experiment jointly by both the internal and external examiners. The external examiner is briefed earlier by the internal examiner regarding the type of questions to be put. The questions usually are based on what the student has written in the journal regarding that experiment.

B. Percentage of understanding/grasping:

From past experience and the response to select demonstration experiments by students and their performance in the examination, the percentage of grasping/understanding of a demonstration experiment is roughly as follows: (The figures are just approximate)\

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Serial No.	Percentage of Various stages of learning	understanding/grasping
1	Write-up of the experiments from charts	10%
2	Detailed explanation by the teacher	15%
3	Actual demonstration by the teacher and observation by students	25%
4	Student-Teacher Interaction (Answers to questionnaire by students) . .	5%
5	Discussion among the team of students	5%
6	Collection of additional data from library	5%
7	Complete write-up of experiment in the journal	15%
	Total:-	**80%**

From the above one finds that 80% of the grasping is achieved by a series of procedures and the remaining 20% may be acquired by studying the same for the examination. It is worth noting that a major contribution in the grasping is due to the teacher and not by the student.

C. Advantages and disadvantages

Demonstration experiments are advantageous from the students point of view and less advantageous or put it clearly more bothersome from teachers' point of view. This is because the teacher has to set up thecomplete experiment initially and give a detailed lecture along with the actual demonstration. He has to take part in the student-teacher interaction and the discussion as mentioned earlier. The teacher has to be virtually on toes almost throughout the demonstration experiment. The only advantage from the teacher's point of view is that the apparatus remains in tact and breakage or damage by the students is avoided. The advantages and disadvantages from the students' point of view are enlisted below:

AdvantagesDisadvantages

1. More experiments can be covered in one turn
   1. As the experiment is studied by Observation, students do not gain

   any techniques or skills in the handling of physical apparatus.

2. Hearing a lecture relevant to an experiment,
   2. There is more imagination than realization
   along with a demonstration helps in better
   understanding

3. The student-teacher interaction and the
   3. As there is a group, time for individual
   discussion help in the gain of additional
   observation is limited
   knowledge.
4. Tendency to gain more information is
   4. As the experiment is not performed,
   developed
   slight dissatisfaction always exists among the students

5. The written material from the charts supplied
   In the laboratory helps further in their theory
   Topics which serve as answers for certain
   questions in the theory paper

6. Complete utilization of the time allotted for the
   Practical session

IV. Assessment And Evaluation

The assessment and evaluation are based on the following questionnaire (Most of the questions are pertaining to practical and term work and few are pertaining to theory) First of all let me make it clear, even though, the readers may not be aware of it that the difference between assessment and evaluation. Assessment is a judgment you get after going through the work done by a student. When you put your judgment in terms of figures, that is, assigning some marks for it, it is evaluation. In other words, to put it simply, Evaluation is the result of Assessment even though these two words are often synonymously used.

1. From the points of view of assessment and evaluation, what points are stressed during the teaching of an experiment?
2. During a practical how do you emphasize the importance of term work?
3. How is an experiment explained before its performance by the student? Do you correlate this explanation in your assessment?
4. Do you depend more on written/printed charts or on explanation or by both?
5. How is the distribution of time adjusted?
6. How many conventional experiments (actually to be performed) are there in a semester?
7. How many demonstration experiments are there in a semester?
8. How are the various experiments classified in the term work evaluation?
9. How conventional experiments and demonstration experiments are assessed and evaluated?
10. What criteria are laid down for the Allocation of marks in the practical Examination?
11. Is the assessment done only by the Internal examiner or by the external Examiner or by both?
12. How is your assessment and evaluation modified in case you happen to help or guide a student during the practical examination?
13. What criteria are laid down for Term Work assessment?
14. Is the assessment of term work comparable wiuth that of practical examination?
15. Do you insist on a minimum number of Experiments for the submission of term Work?
16. Are the teachers biased in the internal Assessment scheme?
17. Are the teachers honest in the internal Assessment?
18. Do you mind in getting the internal assessment verified or checked by a team of external experts?
19. Does the internal assessment scheme create a psychological feeling among the student community that the state of affairs in their learning process is very simple?
20. What is the remedy to avoid such a feeling?
21. Does the scheme help to motivate the students to influence various subject teachers in the assessment and evaluation rather than creating a self-learning process

among themselves?
22. Where there is an internal and external assessment, say, a practical examination, is the internal assessment comparable with that of the external?
23. In the case of a dispute created by whatever means is the teacher prepared to permit a committee of experts and moderators to rigorously scrutinize the internal assessment work done by him?

V. Term Work

A. Present Scheme

(a) Experiments are written in a fair laboratory journal according a common and uniform method of writing to include Aim, Apparatus, Formula, Diagram, Observations, Calculations, Graph (if any), Results and Conclusion in that order.
(b) There is continued weekly assessment of the experiments.
(c) Grades such as A, B, C and D with marks of 4, 3, 2 and 1 respectively are assigned by the teacher taking into consideration of the general aspects of the write-up such as general performance, correct answer, presentation, regularity in submission, etc.
(d) The total number of experiments at the end of the semester and the total marks obtained by converting the grades into marks are transformed into term work by a suitable formula. The formula varies and depends upon the total number of experiments. A typical formula in one case is shown below:

Term Work Marks: 25
Total No. of experiments for the semester: Say, 12
Minimum required for acceptance: Say, 10

Formula for calculation of Term Wok
Let the number of experiments written by a student = M say, 12 which is maximum for the Semester

Let the Gradation = G say 4 which is also maximum
The formula for calculation term work is,

$[\frac{(MG)}{2}] + 1$ Mark added uniformly for all*

The division by 2 is justifiable in order to make the term work out of 24 and when 1 mark is added uniformly to all the term work becomes out of 25.
*It should be noted that 1 mark is added not to each experiment, but to the final term work. It is a grace for all. We teachers can give only marks to students.

B. Advantages of the scheme

1. Assigning marks by gradation for each experiment and then working out the term work by a common formula is much better than an overall assessment for the entire journal.
2. There is a tendency among the students to get better grades for each experiment.
3. The assessment scheme is simple and becomes a **regularized** one.

C. Disadvantages of the scheme:

1. The assessment scheme is not as per the aims of laboratory work
2. Assigning marks by gradation varies from teacher to teacher
3. Students start comparing and point out discrepancies in the assessment.
4. As the assessment is done fast, various aspects such as correlation of the readings in the journaland the readings in the rough journal (log book), regularity in submission, etc. cannot be looked into.

VI. Future Plan For Assessment Scheme

1. Introduction

To get rid of the disadvantages mentioned above, I evolved a scheme of term work assessment during the "Workshop on Term Work Assessment" held in VJT Institute, Mumbai-400 019 on 8th, 9th and 10th August 1983 with the help of the UK Consultant, Prof. Mc Allister and TTTI Experts. The scheme has not been implemented so far and I would like to discuss with the participants present here to what extent the same can be implemented. The scheme is as follows:

2. Various Aims of Laboratory Work

1. To reinforce theoretical studies and thereby understand concepts and principles
2. To discover rules and relationships
3. To observe physical phenomena
4. To identify errors and devise methods for their elimination
5. To select appropriate apparatus
6. To develop manipulative skills to handle apparatus (Avoid damage, breakage, location faults, etc.
7. To complete the work within the specified duration of time.
8. a) To maintain rough records (Log book)
   b) To write up the experiment in a fair journal
9. a) To develop leadership and gain ability for organized team work.
   b) To develop the ability of working as a member and follow organized and systematic team work
10. To develop a habit of enquiry (open mind)
11. To observe safety precautions
12. To interpret results and data and thereby arrive at proper conclusions.
13. To judge magnitudes without actual measurement.
14. To develop a habit of regularized and timely submission of work.

VII. In Order To Make The Assessment More Generalized And Easily Workable, The Above Aims Are Further Summarized As Shown Below

Various AimsAims summarized to

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1.To reinforce theoretical studies and thereby understand concepts and principles.
3.To observe physical phenomena
5.To select appropriate apparatus
6.To develop manipulative skills to handle apparatus
7.To complete the work in the specified duration of time
9. a) To develop leadership and gain ability for organized team work.
b) To develop the ability of working as a member and follow organized and systematic team work
11.To observe safety precautions.
13.To judge magnitudes without actual measurement

I HANDLING OF APPARATUS AND APPLICATION TO WORK

2. To discover rules and relationships
8.a) To maintain rough records (Log book)
10. To develop a habitof enquiry (Open mind)

II MAINTENANCE OF ROUGH RECORDS (Log Book)

2. To discover rules and relationships
4. To identify errors and devise methods for their elimination.
8.b) To write up the experiment in a fair journal
12. To interpret results and data and thereby arrive at Proper conclusions

III WRITE-UP OF THE EXPERIMENT IN A FAIR JOURNAL (including, neatness, order, etc.)

2. To discover rules and relationships.
12.To interpret results and data and thereby arrive at Proper conclusions

IV CORRECT ANSWER/ APPROPRIATE RESULT/ RIGHT CONCLUSION

14. To develop a habit of regularized and timely submission of work.

V TIMELY SUBMISSION

The various <u>summarized aims</u> form a list of "check points"/"criteria" or "Head" with whichthe students' work may be assessed in the laboratory **<u>during the course of his work</u>** and also **<u>after</u>** submitting the report in the journal. The criterion of 'understanding'can be the sixth check point but the same has been omitted in the above scheme as it can be assessed after an examination or a test.

Each experiment may be assessed out of say 10 marks and a scheme of assessment for Term Work is arrived at and the same is given below: (60% weightageis given for the work done by the student in the laboratory and the same is assessed immediately before each student leaves the laboratory)Look at the scheme as given in the table below:

Serial No.	List of Check Paoints/Critera/Heads	Marks
I	Handling of apparatusand application to work (Process)	4
II	Maintenance of Rough Records (Log book)	2
III	Write-up of the experiment in the fair journal (including neatness, order, etc)	2
IV	Correct Answer / Appropriate Result / Right Conclusion	1
V	Timely Submission	1
	Total:. . . .	**10**

In view of this and to facilitate an on-the-spot entry of marks the **<u>Index Sheet</u>** of the Laboratory Journal should modified or got printer as shown below:

Sr. No.	List of Experiments Title	Date of Performance	Marks for each Head I II III IV V	Mark for the Expt.	Signature of Staff
1					
2					
3					
4					
5					
6					
7					

And so on. **Total Marks**:

Term Work Marks out of 25: (After conversion)

VIII. Practical Examination

1. Each candidate will be examined in ONE experiment from amongst those prescribed in the syllabus. The duration for the practical will be 2 hours.
2. Each candidate will be asked to draw by lot ANY TWO experiments (one from the 1st semester and the other from the 2nd semester). Out of the two experiments so drawn by him, he will be asked to prefer ANY ONE which he will be able perform with confidence.
3. Change of experiment is to be discouraged, and if absolutely necessary, 5 marks will be deducted for the same after verification of the laboratory records of the candidate.
4. The performance of the candidate in the practical examination will be assessed out of 50 marks which will be converted to 25 later and then entered.
5. The scheme of assessment is to be done as follows:

a) Connections, adjustments and observations . . . . 20 Marks
b) Circuit diagram, figures and tabulation . . . . 10 Marks
c) Formula, calculations, graph, if any . . . .10 Marks
d) Oral . . . . 5 Marks
e) Correct answer or appropriate result . . . . 5 Marks

Total:. 50 Marks

(To be converted to 25)

6.Each candidate will be JOINTLY examined by both internal and external examiners. (To facilitate such joint assessment, a rubber stamp depicting the following is prepared and the same is stamped in front of each answer book of the practical examination)

Physics Practicals

(Marking Scheme)

Marks obtained

No.	Particulars	Maximum Marks	Int Ext
1	Connections, adjustments and observations	20	
2	Circuit diagram, Figures and Tabulation	10	
3	Formula, Calculations and Graph, if any	10	
4	Oral	5	
5	Correct answer or appropriate result	5	

Total: . . . 50

Average of both Internal and External out of 50: . . . .

Signatures of

1. **Internal Examiner:Marks obtained out of 25: . . .**
2. **External Examiner**

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7.If any candidate is unable to draw a correct circuit diagram, the same may be given by either examiner on request so that the candidate may proceed with the experiment. However, 5 marks will be deducted for the same.

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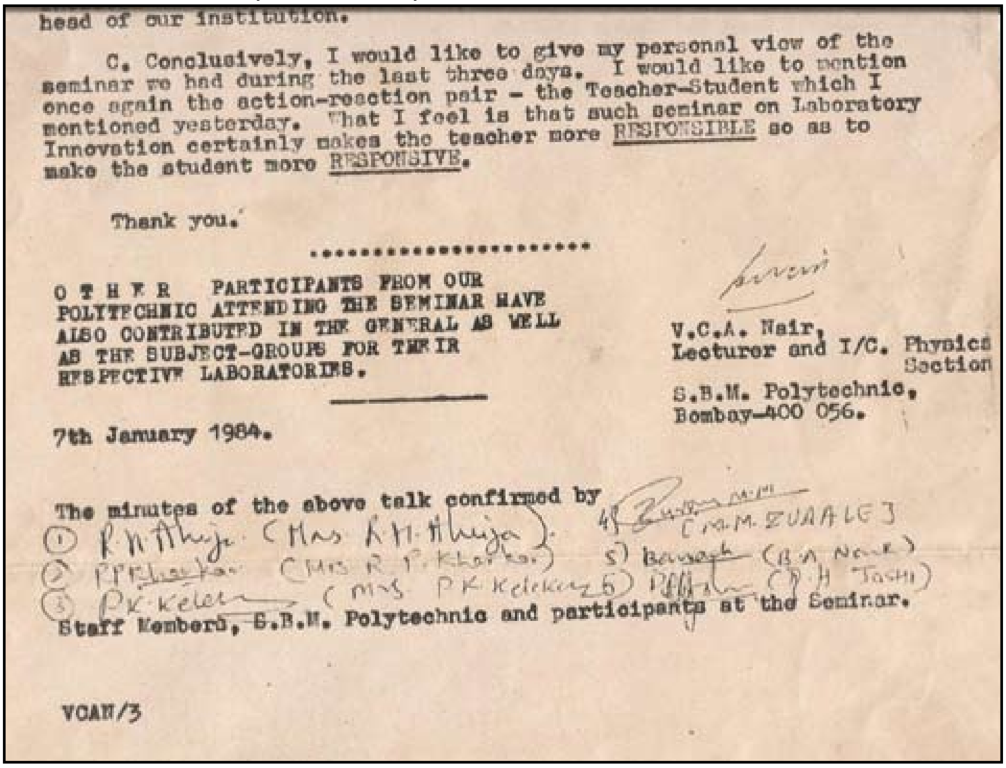
8.While assessing the overall performance and the ability of the candidate to handle the apparatus independently, will be considered.

Feedback session: During the 10 minutes of feedback session, the paper presented by me was highly appreciated by the audience and the general comment by a majority of participants was that the scheme adopted by me lengthy and new entrants as teachers will be reluctant to adopt such schemes.

As an epilogue, and in order to maintain the authenticity of my paper presented and a sort of confirmation of minutes of the session, I produce below the scanned signatures of participants from my institute. As more than 3 decades have passed, none of them is on service to day and sad to say that one of them is no more.



head of our institution.

C. Conclusively, I would like to give my personal view of the seminar we had during the last three days. I would like to mention once again the action-reaction pair - the Teacher-Student which I mentioned yesterday. What I feel is that such seminar on Laboratory Innovation certainly makes the teacher more RESPONSIBLE so as to make the student more RESPONSIVE.

Thank you.

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OTHER PARTICIPANTS FROM OUR POLYTECHNIC ATTENDING THE SEMINAR HAVE ALSO CONTRIBUTED IN THE GENERAL AS WELL AS THE SUBJECT-GROUPS FOR THEIR RESPECTIVE LABORATORIES.

V.C.A. Nair,
Lecturer and I/C. Physics Section
S.B.M. Polytechnic,
Bombay-400 056.

7th January 1984.

The minutes of the above talk confirmed by
1) (Mrs R.M. Ahuja) 4) (M.M. ZUAALE)
2) (Mrs R.P. Kharkar) 5) (B.A. Naik)
3) (Mrs P.K. Kelekar) 6) (P.H. Joshi)
Staff Members, S.B.M. Polytechnic and participants at the Seminar.

VCAN/3

IX. Conclusion

As a part of Research Methodology, I am trying to give an appropriate conclusion for this paper. If one reads between the lines of my paper, it will be found that more stress is laid on demonstration experiments. Demonstration experiments are of ancient origin. There can be more learning by observation than by performance. In order to add quality to my paper, I am presenting 2 pictures. In Fig.1 is shown William Gilbert demonstrating his experiments before Queen Elizabeth. In Fig.2 is shown Volta demonstrating his battery (Pile)

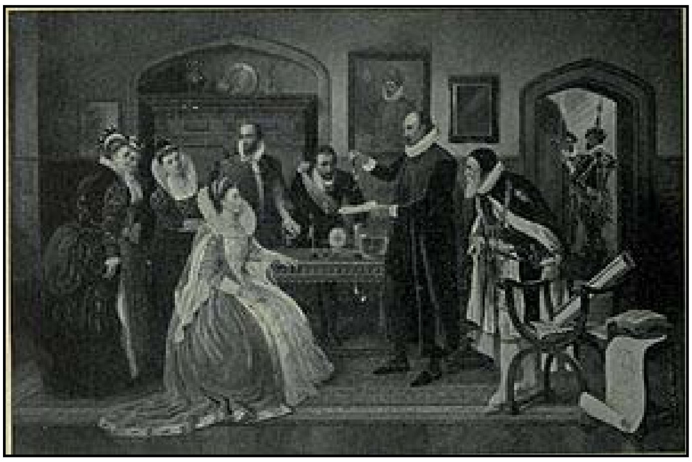

Fig.1 :William Gilbert M.D. demonstrating his experiments before queen Elizabeth (painting by A. Auckland Hunt)

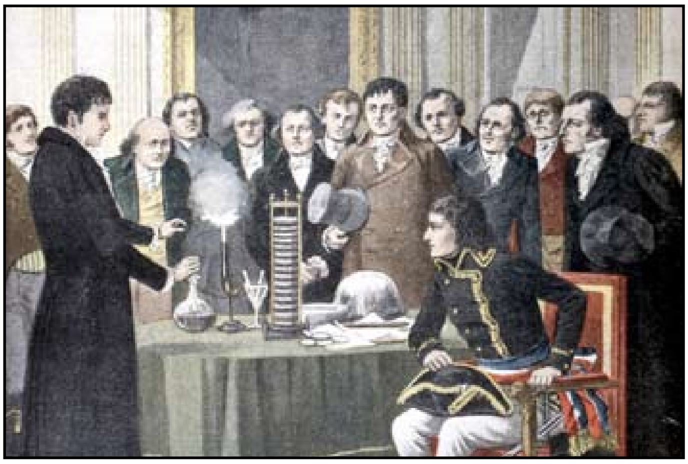

Fig. 2 : Volta demonstrates his battery - "Pile" of alternating layers of silver and zinc –to Napoleon
Bonaparte (seated) and other scientists in 1800. Napoleon was so impressed that he awarded

Volta the medal of the Legion of Honor and made him a Count.

To Napoleon Bonaparte of France. In both the figures, the observation with due attention of the people around is worth noting.

Acknowledgement: I hereby take this opportunity to thank sincerely Dr.Vaidya in-charge of the TTTI Extension Center, Pune for providing all facilities for the entire program of three days. My thanks are also to the UK Consultants, Dr.(Mrs.) Doueck, Prof. Topple, Prof. Haidar and all TTTI Experts for their guidance during the program. I also thank our Principal, Prof. H.C. Patel for allowing me to participate in the program and Dr.D.J. Shah the Academic Dean and Prof. A.C. Mehta the Administrative Dean for extending their co-operation. Last but not the least I thank all the participants for their religious attention during the program

References

The main reference is the "Engineering Experimentation Course" prepared by the faculty of TTTI Bhopal and other additions are due to the vast experience of teaching by the author

Author Profile

**Dr.(Prof.) V.C.A. Nair (b.15th Aug. 1939) is an Educational Physicist, Counselor, Research Guide and Consultant. He did his Masters in Physics from Mumbai University, India and Ph.D. from JJT University, Rajasthan also in India. He has to his credit over 4 decades of teaching Applied Physics in eminent Polytechnics in Mumbai and having taught nearly 16,000 students since 1965. He has published a number of research papers in Physics and Geophysics some of which can be seen in the net 'Google' when the name of the author is typed in that style. He is a Life Member of Indian Society for Technical Education which is an all India body. He had been to USA a number of times and visited eminent Universities such as Stanford, Harvard, MIT, University of California both at Berkeley and Los Angeles and University of San Francisco, University of Princeton at New Jersey. At present Dr. Nair is a Research Guide at JJT University, Rajasthan-333001, India . His Ph.D. Thesis is in Geophysics and he is working on topics such as Tides, Clouds, Global Warming and Climate Change. *nairvca39@gmail.com*