

IMPROVING RESEARCH QUALITIES OF PHYSICS GRADUATES BY IMPROVING TEACHING METHODS

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Abstract—Modification in teaching methods of physics as inclusion of ‘research based teaching’ for better training of students can improve Physics knowledge and enhance research qualities and career opportunities for Physics Graduates in research field. Analysis of the response obtained by survey through asked questionnaire from students of different background of primary knowledge of science shows that Physics subject should be taught through Demonstration , experiments on models, discussions in small groups of students, presentations by students in groups and Explained its applied aspects by visits to different research institutions and industries. Mentorship is an important part as it gives teacher-student direct interaction opportunity to remove difficulties in subject learning.

KEYWORDS—Teaching Methods ;Research Based Teaching ,Dual Role Mentorship;

I. Introduction: The quality of teaching and research in Indian universities and colleges is not up to the mark. without defined guidelines the dual role of teachers for teaching and research become very difficult and one gets completely neglected. Teachers gets promotions based on their research publications, papers presented in seminars/symposia, books written, membership of various academic societies, etc., but much importance is not given to the teachers’ who give good contributions towards teaching. This type of situation tempts many teachers to neglect teaching and take up some sort of research mostly , unproductive, outdated and repetitive type and publishing substandard research articles. The system normally recognizes quantity like number of papers published, number of Ph D students guided etc. rather than quality of the research and publications. Unfortunately, no concrete method is developed so far to judge the teaching and research aptitude of teachers. Some academicians argue that both teaching and research cannot be done at the same time. However, it is generally thought that education (even from undergraduate level) and research should coexist to complement each other. Universities and Colleges

, impart postgraduate education, and conduct research in a variety of disciplines. Universities and colleges have great responsibility in producing quality researchers and teachers for the education, science and technology systems. Research and teaching are the dual role of the teachers. The objective of development of research attitude in the younger generation can be achieved with the development of teachers’ personality. Teaching includes teacher, teaching methods ,content and learners.

A **teaching method** used by teachers to present content to enable student-learning, comprises the principles and strategies which depends partly on subject matter to be taught and partly on the nature of the learner to encourage creativity. There are two approaches for teaching (1) student centered and (2) teacher centered.

In physics teaching , up to now mainly lecture method is used for theory classes as it is convenient and cost-efficient, especially with larger classrooms of hundred students . There are different techniques for increasing interest, attentiveness and active participation of students in teaching e.g. demonstrations, discussions in small groups, collaborative learning, effective laboratories. Teaching or learning about science (physics) necessarily require laboratory or field work. Experimentation underlies all scientific knowledge and understanding. They provide students with opportunities to think about, discuss, and solve concept based real problems. Developing an effective laboratory and teaching through them require much skills, creativity, and hard work as proposing and executing a first step for **research project**. Despite the importance of experimentation in science, introductory labs fail to generate the excitement for discovery to the majority of our students. ‘Improving undergraduate laboratory instructions’ should become the priority in many institutions. It is important to think about its goals. Here are a number of possibilities:

1. Efforts to appreciate the role of experimentation in science.
2. Develop deep understanding of concepts of Physics and applied in new situations.
3. Experiencing basic phenomena and develop skill to use scientific apparatus.
4. Develop skills for experiments and data analysis.
5. Learn to estimate statistical errors and systematic errors.
6. Exercise designing a procedure to test a hypothesis.
7. Testing important laws and rules.
8. Practice collaborative problem solving.
9. Develop reporting skills orally and in written.

The ability to write and speak clearly is important, and various practice sessions help students to develop these skills. Another important skill is the ability of working in a team, and using the abilities of the individuals of that team to the maximum advantage. These skills can be developed in workshops and project classes.

II. Material and Method: “Improving Research Qualities of Physics Graduates by Teaching methods” is the basis of the questionnaire for present survey and data collection, is reported below:

Questionnaire:

Part A: Personal Details

1. Age- _____ years
2. Gender (M/F) -----
3. Educational level: Studying in _____ (If student)

Part B: (Data) Questionnaire for collecting responses-UG students

Q.No	Question	Response
1	Lecture method of teaching is the best method. (Yes/No)	80%
2	In any class ‘Teacher / no of students’ ratio for better interaction should be 1/ 20 . (Yes/No)	100%
3	In your class ‘Teacher / no of students’ ratio is (i)1/ 20 (ii)1/40 (iii)1/50(iv) 1/70(v)1/100	85% 1/100
4	After teacher’s explanation, notes should be prepared by students as home assignment. (Y/N)	50%UG
5	Some part of lecture time must be utilized for active participation of students. (Y/N)	60%
6	Presentations/Seminars of short duration should be the part of student activities. (Y/N)	75%
7	Time distribution of teaching of 100 lectures. (one lecture = 1 hour session)	
7(1)	Number of theory Lectures = _____lecture(s). [50,60 ,70,80]	Avg= 60
7(2)	Number of Numerical solving session (Tutorials) =.....lectures [20,30,40,50]	Av= 30
7(3)	No of Practical explanations = _____lecture(s). [2,4,5,6]	Avg=5
7(4)	No of Practicals = _____ lecture(s). [20,30,40,50]	Avg= 30
7(5)	Demonstrations = _____lecture(s). [8,10,12,14]	Avg=8
7(6)	Visits to Industry/ Research Institutes = _____ lecture(s). [8,16, 24,32]	Avg=8
8	How beneficial are guest lectures? a)0% b) 25% c) 50% d) 75% e) 100%	86% (c)
9	Additional information must be given in lectures for better understanding of the topics.(Y/N)	80%
10	Short term projects based on concepts can be associated with Physics learning. (Y/N)	93%
11	Is discussions in small groups of students on physics concepts beneficial .(Yes/No)	87%
12	Short duration presentations by students in groups on different topics be necessary. (Yes/No)	60%
13	Test in groups can generate healthy and usefull discussions . (Yes/No)	100%
14	Teaching aids eg Videos, working models etc are very helpful for understanding concept in classroom.(Y/No)	(Y) 100%
15	Do you feel subject physics tough (Yes/No) Reason:	(Y) 50%
16(1)	Is mentorship helpful for studies for students.	(Y)

		65%
16(2)	Do you feel your mentor helpful in your solving Problems in subject understanding.	60%
16(3)	Mentorship :one meeting with student of 1hour per week / <u>month</u> / semester is sufficient .	60% Per m
17	Project should be compulsory in Physics graduation. (Yes/No) If Yes,Which project you would be interested (to be involved) in -	(Y) 62%
17(1)	Short term project for teaching basics of Physics in schools of primary science education.	50%
17(2)	Renewable energy based projects.	37%
17(3)	Electricity generation by solar panels.	37%
17(4)	Heat /Fire/sound sensors making.	37%
17(5)	Water level sensors making.	37%
17(6)	Review type study on Physics topics /discovery	75%
17(7)	If not above, Write your choice of projects :	86%
18	Do you want carrer in research. (Yes/No) Reason :.....	(No) 70%
19	Project based teaching/learning can improve research qualities of Physics graduates when involved in research work.	80%
20	Project based teaching/learning can increase job opportunities for Physics graduates.	100%
21	What changes should be made in teaching methods so that graduates can be able to pursue research field	

III: Result and Discussion :It is clear that most of the students are compelled to study in big class of strength of nearly 100 students per class, so *lecture method* is adopted as it is difficult for a teacher to interact with each student individually. Students prefer that teacher should not provide prepared written notes, preferably assignments be given for notes-preparation for better understanding of the subject. They should provide proper references for the study. Students should also be given opportunities for actively participating in class like short presentations, demonstrations, quizzes, short duration industrial visits and guest lectures of the level of students for maximum benefits. Students should compulsorily submit the report of the activities they were involved in and then attempt the questions based on reports submitted. Then discussion but with whom. Most important need is the mentorship for students. Purpose is for interacting with individual learner for getting and discussing feedback on all activities. At least one meeting of one hour per week is highly recommended for interaction after all activities of one week. Teaching aids are an integral component in any classroom teaching. Teaching aids engage students' other senses when supplementing a lesson which is the present need of students. Benefits of teaching aids include learners improving their reading comprehension skills, illustrating concept, differentiating instruction and relieving anxiety or boredom by presenting information in an exciting way. Undergraduate students of past year have less exposure to research environment in degree colleges, so have less interest towards projects and as they are habituated to studying so most of them have opted for review type projects in Physics. Very few students have shown their interest towards research as career which is the first step of the understanding of what is the present situation and the situation in coming ten years of the research field. After graduation other careers look more interesting as compared to research. Main reason is that students think physics is tough subject which is also the reason for absentees in class. For making class goal oriented, and students take more interest *Two test method* can be adopted in which at the end of every lecture there should be the compulsory short time test/question-answer session (first test) based on content taught and after one week lectures, second test to match the difference of knowledge and efforts given by students to understand the contents. Every week, every month, then semester-end testing and *then final exam* for evaluation along with adopting different teaching methods as requirement of the topics, considering individual differences of students can give better results of teaching and students with good basic knowledge which are the inputs research institutions expect. Second important part is the *content* in undergraduate (UG) and post graduate level (PG) be framed such that it become the basis of research field and *training courses* of the necessary tools used in research field of Physics eg usefull software training, familiarity with instruments and methods.

IV: Suggetions :Qualities of research can be enhanced (1) If more number of PhD students is the requirement then instead of putting burden of research on college teachers which are lesser than number of students, emphasis should be on improving content and methods of research, making attractive to students.(2) Removing difficulties of research fields.(3) After students' Graduation if Research institutions offer their requirement based short term training courses /bridges courses before joining research careers by students.(3) If research institutions organize short term workshop for teaching basics of their fields to make

students' familiar with research fields.(4) Considering basic requirement of life, the environment in research institution should be made like that PhD students should feel to do research.(5) During research, Students-Guide meetings should be monitored officially so that Guide should not get opportunity of spoiling most active and important time of life of learner to give depression. Research Work should be object oriented.(6) Time duration of PhD degree should be considered as temporary full time job with monetary benefits and job experience_so that PhD holder should not feel as no where. etc.....

V: Conclusion: Conclusion is Teaching methods and content (syllabus) in UG and PG level play important role in making Physics subject understandable and useful to provide better Inputs to research field. 'Research oriented project based teaching and learning' in basic sciences can **Improve Research Qualities of Physics Graduates which can** increase the job opportunities and profile of Physics graduates be upgraded like other professions. Including projects in curriculum can improve understanding and applied part of Physics. First time, this year in TYBSc physics ,the project is made compulsory for students. Physics subject should be taught through demonstration , experiments on models , discussions in small groups of students, short duration presentations by students in groups, tests in small groups of students and explanation of its applied aspects by visits to different research institutions and industries. Mentoring is also an important part for taking care individual differences of students and getting feedback to remove difficulties in learning.

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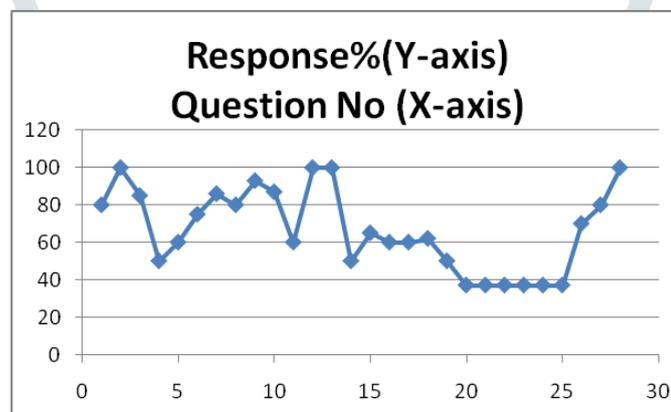


Fig.1 Response of undergraduate students

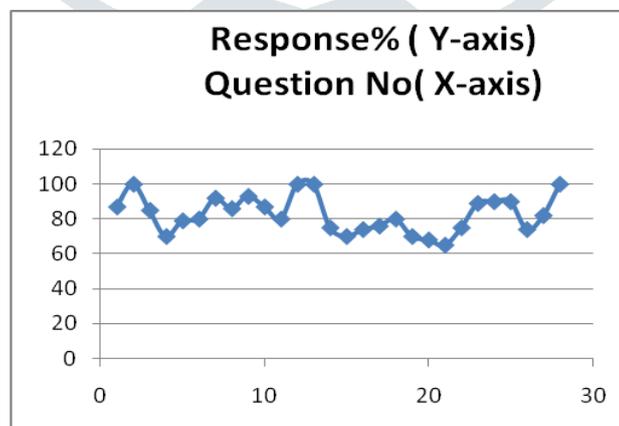


Fig.2 Response of postgraduate students