Causes Responsible for Declining Interest of Students in Learning Physics at Higher Level: An Indian Perspective

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Abstract

In the recent years there has been a sharp decline in the number of students opting for higher education in Physics. Physics is a fundamental subject required for any new technological application. It generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world. Due to various reasons, this prime subject is losing its popularity. Poor middle school preparation leads to poor performance at higher secondary or pre-university level. In present study, various reasons responsible for this state of physics education in the country are discussed and also some suggestions are given to improve the teaching and learning process of Physics education.

Keywords: Physics, education, teaching, learning, curriculum.

Physics education in India: An Indian Perspective

Physics is an experimental science whose aim is the observation, description, modeling and understanding of the natural world in which we live. It is a science composed of well founded expectations of how the natural world should behave. It is an exciting intellectual adventure that inspires young people and expands the frontiers of our knowledge about Nature. It generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world. Physics as a subject contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific developments and
discoveries. A high quality science education in primary and secondary schools contributes to developing scientific literacy and would be expected to predispose students to study the enabling sciences at University (Rosemary S. Evans, 2009). In order to enhance our understanding of other disciplines, such as the earth, agricultural, chemical, biological, and environmental sciences, plus astrophysics and cosmology - subjects of substantial importance to all peoples of the world. Physics improves our quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for medical applications, such as computer tomography, magnetic resonance imaging, positron emission tomography, ultrasonic imaging, and laser surgery.

Unfortunately for last five years, there is a sharp decline in the number of students opting for Physics at university level (George Varghese, 2005). There appears to be general agreement among people that the quality of education imparted at higher level needs drastic improvement (Antony Stella, 2004). Science seems to be losing out to other disciplines. (G. Padmanabhan, 2008) A few universities and colleges have closed down their science departments. (Rosemary S. Evans, 2009). With the number of Indian students studying physics falling to its lowest number in over a decade, education officials have to deal with an unexpected problem: How to make Physics seem interesting to the young students (Sushila Khilnani et al, 2004). Science is one of our country's great strengths and the jobs of the future are increasingly going to be hi-tech and science based. That's why we need all young people getting excited, doing experiments and learning about science in primary schools and going on to study science in more depth at secondary school (Garg K. C. et al, 2003). Experiments teach children practical methods and skills and also how to test hypotheses, but they are also fun and challenging and make learning come alive. While the number of students studying chemistry and biology is on the rise, physics is falling foul of student apathy in Indian schools. An interaction with the students at school and Degree College revealed that many students, who studied Physics at Junior college or +2 levels, did not opt for Physics at University level and lost interest in learning the subject due to various reasons. Some of them are mentioned below:

1. Weak understanding of basic physics concepts. Physics is a systematic study, a discipline that attempts to quantify reality through a precise application of observation coupled with logic and reason. In order to make use of such a discipline there is certain foundational information that the students must understand first, in order to build upon it. If the basic concepts are not clear to the students, they find it difficult to build their understanding of the subject, to appreciate its importance and arrive at some result.

2. Non-availability of well qualified, dedicated teachers. The primary and secondary level education lays the foundation for future academic endeavors. Therefore, it is of utmost importance to make sure that the students receive the best quality education imparted by well-qualified, competent, and dedicated teachers. Unfortunately it is very difficult to find trained post graduates Physics teachers to teach Physics in rural as well in urban schools in India.
Some of the private schools are able to attract competent teachers by paying high salaries and providing other facilities.

3. Finding difficult to establish a correlation between Physics and their day-to-day activities. Physics is the science of matter and its motion, space-time and energy. Physics describes many forms of energy - such as kinetic energy, electrical energy, and mass; and the way energy can change from one form to another. Everything around us is made of matter and Physics explains matter as combinations of fundamental particles which are interacting through fundamental forces. We can find Physics as the backbone for our daily life example such as an electric light, electricity, the working of our vehicle, wristwatch, cell phone, CD player, radio, plasma TV set, computer, and - the list goes on. Very few physics teacher make use of real life examples while teaching Physics in the class room. As a result students find it difficult to correlate what is taught in the class with day today activities.

4. Not being able to apply what they knew to new situations. Learning is more likely to occur when the learner is actively engaged with the instructor and with other learners in exploring ideas and testing solutions. Most of the students study Physics keeping in mind the only objective as scoring good marks in the examination. Subject should be taught in a manner that students enable themselves to apply the concepts in a variety of situations. To encourage this, frequent class room discussions should be organised on a given problem and students should be encouraged to find as many solutions as possible.

5. Believing that Physics is just a collection of mathematical formulae and equations. In most of the schools Physics is taught by chalk and talk method. Physics teaching can be made very interesting if the concepts are taught by demonstrating some experiments. Children love to see experiments rather than just learning on the black board. Most of the basic principles of Light, Electricity and magnetism can be taught by simple experiments using inexpensive materials.

6. Minimum or no use of any audio-visual aid while teaching complicated concepts. Most of the schools in India do not have well established laboratories. But simple models can be made and utilized as audio-visual aids. Students should be given the idea of making working models of some devices or machine and should be displayed by organising a competition or exhibition. Those models can be used while teaching physics. It will develop scientific attitude among the students and they will get a sense of achievement. In schools where internet facilities are available, teacher should make use of all the interactive programmes, websites and pictures available to make the learning more effective and interesting.

7. Inadequate examination system which gives more importance to scoring marks in theory papers than hands on experience in the applications of the concepts. The education system in India was examination-ridden and tended to curb the teacher's initiative, to stereotype the curriculum, to promote mechanical and lifeless methods of teaching, to discourage all spirit of experimentation and to place stress on wrong or unimportant things in
education. Fortunately, the education policy makers have realized it and most of the educational boards/ universities in India are redesigning and updating their curriculum.

8. Poor infra-structure and ill-equipped laboratories. Most of the schools in rural areas are in a dilapidated condition. Laboratories are not well equipped. Instruments old and damaged. It makes the students uninterested in learning physics.

9. Inability to see the concepts of Physics as the basis for the technological advances. Physics and technology are deeply linked together. is interested in extending the knowledge base of various aspects of the natural world and phenomena by systematic study, effective experimentation and authentic analysis; and probe why and how do things happen, but may not necessarily be interested in practical applications of these findings. Whereas, Technology is concerned with innovative applications of scientific intellect and inventions. Physics Teaching should emphasize on the fact that all the technological developments are possible because of the understanding of the basic principles of science.

10. No upgradation of syllabi with the fast technological development. There has been tremendous technological progress in almost all the spheres of life. In fact, technology is at the very heart of human progress and development. But syllabi have not been upgraded according to the technological advancements. Students do not like to learn the topics which are hardly of any use to them in future.

11. Lack of coordination between industrial requirements and academia. There is a complete lack of coordination between the academia and industries. After taking a course at university level in Physics, the students still find difficult to get jobs in the industries. This leads to frustration and discouragement among the students and they opt for more job oriented courses.

12. Limited number of seats available for further education and research in Physics in premiere research Institutes (P.Balram, 2002). There are very few seats available for higher education in premiere institutions and selection criteria is also tough. The students who might be genuinely interested to pursue higher education and research in physics may not get admission just because he could not pass qualifying test/exam or selection interview.

13. High fee structure in well equipped private colleges. There are many self financed private colleges in India offering advance courses in Physics with latest curriculum and well equipped laboratories but the fee structure is too high and may not be affordable to all.

14. Fewer job opportunities. A graduate level course in physics does not offer attractive job opportunities to the students as a graduate course in Engineering/Medical or Commerce offers.

15. Peer pressure to join courses having ample job opportunities.

16. Lack of encouragement from parents and teachers. Parents also pressurize to take up the courses with better job opportunities and do not encourage their children to take up courses which do not offer ample and lucrative jobs.
Some suggestions to improve the learning of Physics

Developing our own Physics teachers
1. Identify students with talent and keen interest in Physics who like to teach as early as high school; pay their full tuition and expenses for a college degree through a conditional loan payment.
2. Organize for a two year intensive teacher induction program for every teacher in Physics. In the first year of the program, the intern teacher would be paired with the team teach all classes with a veteran teacher. During the second year teacher would be trained for the latest teaching methodologies and other technological aspects of the subject.
3. Provide the opportunities to the students interested in Physics from the high school level to interact with the Senior Scientists from premiere research institutes to develop curiosity and interest for higher education and research.
4. Promote training and education of more women teachers; create more job opportunities for them. Completely remove age bar for women in teaching/research jobs as most of the women take a break for child bearing and bringing them up or in looking after aging parents and for other such social reasons which are all very important and should not be ignored. Many of the women teachers and scientists, who are very bright and talented and want to continue their profession, have to resign from their jobs forshouldering such social responsibilities.
5. Provide financial assistance, scholarships to the students who want to pursue higher education in Physics in India and abroad.

Improving skills, knowledge and retention of current Physics teachers
1. Employ Physics experts in all elementary schools to assist other teachers and provide one-on-one assistance to the most challenging and gifted students.
2. Facilitate good professional development for all teachers of Physics specially focusing on elementary and middle school teachers who may not be Physics specialists.
3. Provide Physics subject matter experts as mentors and coaches in elementary and middle schools.
4. Motivate teachers and their professional organizations to actively participate in designing and differentiated compensation plan.
5. Organize summer internship and paid sabbatical opportunities for Physics teachers to learn more about the practical application of the content they teach.
6. Develop a research based way to improve working conditions of teachers as about a half of all new teachers appointed, leave the organization within three years. Serious efforts should be made to reduce teacher attrition with a special focus on time, leadership and other facilities.
7. Provide common planning time for teachers so that they can collaborate on curriculum development and articulation, evaluate student work and help the students in the subject.
Adopt new and innovative teaching methodologies in Physics
Physics is a process, not a list of accepted facts. However, it is generally taught as a body of knowledge with historical references to people and maybe classic experiments that established this knowledge. Rather, Physics should be taught in a manner where emphasis should be placed on methodology, what constitutes a proper scientific hypothesis, and how the scientific process unfolds over time. This will necessarily include discussions of things that are currently unknown, or very controversial. If students were made to debate on the topic being taught, they would learn the relevant facts and process much better than simple memorization.

4. Design curriculum in coordination with the requirements of industries. Invite industrialists and entrepreneurs to interact with the students and implement their suggestions while designing curriculum.

5. Change examination system. Develop an evaluating process which does not aim to only score good marks in the examination rather promotes learning of the subject and its applications in daily life.

Encourage active participation of the students in classroom teaching by answering their questions.
Questions that grab the imagination and ignite the analytical thinking of the child, should be discussed in the class. The aim should be to show students how to formulate scientific arguments.

Teach how to access scientific information
Higher level courses in Physics should include lessons on how to find reliable scientific information, and then assess that information to form an opinion or answer a question. The internet now provides an excellent and easy resource for such lessons, but books, magazine, and encyclopedias should also be utilized. Students should be provided an easy access to internet and journals, magazines, educational CDs on various topics.

Include more practical sessions to teach difficult topics
Humans learn better when they are actively involved in that activity. Getting students to actually perform experiments is therefore a good idea. Different types of experiments can be performed by the students to understand the concepts better. Students could also be asked to run experiments to test certain unknowns, and the results compared among the class. This would demonstrate the variability of research outcomes and explain the fact that why replication is so important. Difficult experiments can be demonstrated by the teacher. Here the students are more passive observers. Rather than doing an experiment they can be shown a demonstration of whatever scientific principle they are being taught. Such demonstrations always help in better understanding of the concepts.

Develop critical thinking among the students
Critical thinking skills should be woven into every part of the Physics curriculum.
Physics is a way of thinking about the work and figuring out how it works. The primary tool of learning Physics is the mind – and while curiosity may come naturally to humans, scientific thinking is a discipline that requires teaching and practice.

**Introduce new courses, programmes relating Physics with Technology**

New courses at University level should be introduced where theoretical concepts of Physics go hand in hand with technological applications. The courses like Physics Engineering equivalent to a B.Tech degree course should be introduced and curriculum should be designed keeping in mind the latest technological developments and requirements of the industries. It should be a collaborative effort between Industries and academia and students graduating with this course should get immediate employment in Industries.

Introduce training programmes exclusively and develop future entrepreneurs to create more job opportunities in Physics. Arrange for the training and loan facilities to start their own business in turn creating more employment.

**Creating a better system of Physics Education**

1. Make maximum use of colorful, enjoyable activities to generate interest among the children at pre-primary school level.
2. Evaluate all the on-going Physics teaching initiatives in the country, assess their success in improving learning of Physics and expand which are proved successful.
3. Give sufficient time for the recently enacted changes to be fully implemented and their success assessed before mandating additional changes such as increased graduate requirements in Physics, examination and evaluation process at the end of the course.
4. Provide required support for schools through professional development, appropriate university course work for teachers and making materials and supplies available.
5. Arrange for grants for Physics instruction improvement and innovation to be used in improving the students’ performance in Physics and make it available to all the schools at all levels with the choice for the school to determine what specific scheme would best address their own issues.
6. Fund generously the organizations working for the development of the subject like Indian Association of Physics Teachers.
7. Identify the slow learners and gifted students and arrange for separate teaching sessions with different methodologies.
8. Significantly improve infra structure, lab equipments to support better Physics learning.
9. Invest seriously in the emerging revolution in different areas of Physics and in Institutes designed to translate that knowledge into curricula, innovative programs and other related materials that will work for average teachers and students.
Encourage the efforts of the family to help student achievers

1. Organize for a national level seminar to show parents and students the opportunities and courses available in Physics.
2. Arrange for systematic home work assistance for the students taking challenging Physics courses specially the children who may not have parents to help them with their studies.
3. Organise for summer camps for interested Physics students at all levels so that they begin the next academic year with confidence and better understanding in the subject.
4. Popularize Physics by taking the students to museums, radio/TV shows, exhibitions, interschool / intraschool quiz competitions.
5. Organise Physics club competitions between elementary and middle schools and between middle and high schools to showcase Physics at the higher level, encouraging students to strive for high achievement. Do invite parents and teachers to participate.

Its really encouraging that Education Policy makers in India have taken a serious note of students turning away from learning basic sciences. Indian government, Department of Science and Technology, premiere Institute and many more such organizations in India are in the process of updating curriculum, implementing new programmes, designing new courses in Physics and other science subjects, promoting more research and development programmes and trying to attract students towards pure sciences and we can expect a large number of students taking up Physics courses and research work.

References