Student attitudes towards physics: concerns and solutions

Shaweta Mohan

1. Assistant Professor, Department of Physics, BBK DAV College for Women, Amritsar, Punjab, India

Correspondence to: Mail: shwetamohan_82@yahoo.co.in, Mobile No: 09876042792

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ABSTRACT

This work gathers the student’s perceptions about physics and their expectations from teachers and course instructors. This is particularly important considering the decline in popularity of physics among students. The study is an effort to explore why students think physics as a difficult subject and what can be done to make it more interesting and attractive to them. Students studying in undergraduate and postgraduate courses affiliated to Guru Nanak Dev University, Punjab, were asked to fill a related questionnaire. The results indicate that most of the students believe that physics is interesting, but they want some changes in the traditional content of their course curriculum. Students would prefer to study topics like astrophysics, geophysics, environmental physics and biophysics so that they can see more connection between their studies and everyday life. The use of demonstrations to scaffold the student’s understanding of the subject needs to be encouraged by the teachers. Without any doubt, the student controlled factors such as weak base, insufficient self-study, lack of interest, do influence their success in physics. The study has revealed some of the changes required in course curriculum and teaching methodology, which we as teachers should attempt to enhance student’s interest in physics.

Keywords: Perceptions, curriculum, teaching methodology, student interest.

1. INTRODUCTION

Physics being the most basic and fundamental science is important for many fields of human endeavor. It is crucial in understanding the world around us, the world inside us and the world beyond us. The goal of teachers is to prepare the young generation for life in the current scientific-technological era. But the cause of concern is that most of the students consider physics to be difficult without really understanding the beauty of the subject. A dearth of students willing to study physics is recognized as an international issue (Chaisson and Kim, 1999) and henceforth research is needed on this aspect to identify both the context-specific and generic causes in various educational systems. In studying student understanding of the basic concepts of physics, it has been revealed that students are not “blank pages.” Their experience of the world leads them to develop many concepts of their own. Many different names are used for these kinds of concepts. The well known and frequently used names for these ideas are: “alternate conceptions”, “misconceptions”, “children science”, “conceptual misunderstanding”, “spontaneous ideas”, “intuitive ‘law’ or spontaneous reasoning”, “conceptual framework, students’ unscientific beliefs (Gilbert and Watts, 1983; Marin et al. 2000). These concepts are often not easily matched with those that are being taught in physics courses, and students’ previous conceptions may make it difficult for them to build the conclusions the teacher desires (Redish et al. 1998). It has been explained (Redish, 1994) why students describe physics as difficult, in a different way: “Physics as a discipline requires learners to employ a variety of methods of understanding and to translate from one to the other—words, tables of numbers, graphs, equations, diagrams, maps. Physics requires the ability to use algebra and geometry and to go from the specific to the general and back. This makes learning physics particularly difficult for many students.”

The quality of physics instruction and education can be improved by student centered and research based education, individual and group works and with reflection of physics to real life (Bell, 2001). It is very important to probe the student’s preferences, feelings, motivations and perceptions about physics. Beginning about 1980, research began to show that the ‘traditional class’ leaves most students confused about the basic concepts of mechanics (Vienne, 1979; Trowbridge and McDermott, 1980; Caramaza et al. 1981). Subsequent work extended these observations to other areas including optics, heat and thermodynamics, and electricity and magnetism (McDermott, 1991). The views of faculty members and students about learning and understanding physics are found to be quite different. According to Carter and Brickhouse (1989), “students, faculty, and teaching assistants will live in different worlds and it will be difficult to communicate because they speak different languages”. Redish (1994) adds “…we don’t understand most of our students and they don’t understand us…”

In this milieu, with the aim of gathering student’s views about their difficulties with physics and teaching methodology, we have surveyed the students studying in undergraduate and postgraduate courses in various colleges affiliated to Guru Nanak Dev University, Amritsar. This would comprehend the approach of students towards physics and the requirement of allied changes to be made in course curriculum and teaching of the subject. It would help to de-accelerate the force driving the generation to this negative view of physics.
2. METHODOLOGY

The perception of the students carrying out their bachelor’s and master’s degree was congregated using a concise questionnaire containing 30 questions. The questionnaire was distributed among students studying in B.Sc. (Non-Medical), B.Sc. (Computer Science) and M.Sc. (Physics). The duration of B.Sc. and M.Sc. courses is three and two years respectively. The students carrying out their bachelor degree are taught three disciplines of physics every year along with mathematics and chemistry/computer science as other subjects. The M.Sc. students study exclusively eight different disciplines of physics. A total of 412 copies from B.Sc students and 93 copies from M.Sc students were recovered. Response of the students was fervent and voluntary. The completed questionnaires were scrutinized and the most common replies were divided into four categories:

1. Student controlled factors
2. Factors inherent to nature of physics
3. Course related factors
4. Factors controlled by teaching methodology

3. RESULTS & DISCUSSION

The response of students was quite encouraging and optimistic. The results of the survey are presented under five separate headings. These have been shown factually in tabular form followed by discussion of the same.

3.1. Student Controlled Factors

Factors such as study habits, student interest and their background knowledge do have a vital impact on student’s perception to physics as a subject. These factors and the student response to them are presented in Table 1. An appreciable percentage of students admit that they solve practice problems occasionally, which result in their abridged interest in physics. An important point to note is that a very few percentage of students believe that they possess a strong background knowledge of physics. This may be due to the fact that students are burdened with loads of syllabus during their high school, in order to prepare for various competitive exams. The trend among the students is to run after various coaching centers which do not provide them sufficient time for self study. Teachers should bear in mind that college is a striking change for most of the students. Students would like to put more effort to change and grow in physics if they are motivated and enlightened to have a deeper understanding of the subject. Even though a high percentage of students concur that they joined the course because of employment and future salary prospects, they also decline to have lack of interest in physics.

Students should bear in mind that in studying physics, perhaps more than in any other subject, it is necessary to develop an ability to analyze problems, to reason logically, and to discriminate between important and irrelevant material. Consequently, efforts to memorize physics are practically insignificant. Students should not avoid asking any type of questions and participating in classroom activities when they do not understand or their thoughts and concepts contradict with teachers. Students should be enlightened to solve all types of problems- obscure to mundane. With the dream of becoming a physicist, they should remember the words of the great scientist Einstein “I think and think for months and years. Ninety nine times, the conclusion is false. The hundredth time I am right”.

3.2. Factors Inherent to the Nature of Physics

Physics seems daunting to students because of some factors which are inherent to the nature of physics. These have been summarized in Table 2. A high percentage of students believe that physics is cumulative. If they miss one concept, it is hard to grasp the next one. It is true because many apparently different laws of physics follow from a more general principle. A majority of students correctly believe that physics can not be learned without mathematics background. Physics has treaded an ample and safe course towards crescent mathematical practices (Paty 1999). Currently, mathematics is definitely lodged
in the core of physics by means of functions, equations, graphics, vectors, tensors and geometries. So students should practice to improve their mathematical concepts for a better understanding of physics. Students do not seem to be afraid of the experimental component of physics. In order to endow the students with better clarity of concepts, more stress should be paid on the experimental part. “In the matter of physics, the first lessons should contain nothing but what is experimental and interesting to see. A pretty experiment is in itself more valuable than twenty formulae extracted from our minds.” -- Albert Einstein. As is clear from the results greater percentage of M.Sc. students find physics to be very interesting as compared to B.Sc. students. This may be because they come in touch with wider concepts and disciplines resulting in an increased interest, growth of sophistication and a deeper understanding of the subject. Consequently, even if the students find physics difficult at the introductory level, their perceptions can change at higher levels.

3.3. Course related factors
Student’s acuity of the nature and content of curriculum is one of the important factors that dissuade them from pursuing physics at more advanced levels. The response of the students to some of these factors is presented in Table 3. The data indicates that a substantial percentage of students are not completely satisfied by their course curriculum. They want more practical work to be included in their syllabus. On analyzing the results it appears that students feel burdened to study more disciplines of physics. The students feel that they do not get sufficient time to participate in the extra-curriculum activities. Trivial interest of science students in participating in various academic and cultural competitions is the generally observed trend in colleges. A high percentage of M.Sc. students agree that their interest in physics grew after joining the course. In the light of these findings, it is clear that the physics education curriculum should be improved. There is need to uplift practical physics education by increasing the experimental part in the curriculum and providing sufficient laboratory facilities. The course instructors should employ the curriculum in a way which lessens student’s difficulties of understanding and learning of physics. Our courses should not reward students with inappropriate attitudes, such as those who prefer memorizing to understanding. This may drive away students who might excel in physics given they are provided a more supportive structure. The curriculum should encourage the students to develop scientific hobbies and involve in preparation of physics models and projects which can enhance their understanding of the subject. There is no doubt that mathematics is definitively lodged in the body of sciences and the university curriculums reflect such perception, with substantial emphasis on mathematical training. The relationship inferred between physics and mathematics from university curriculums reflects a type of "professional prerequisite" hierarchy: “to study physics one must know mathematics, that being the case let us teach it first!” The courses in physics include many mathematics subjects such as linear algebra, geometry, advanced calculus, etc. This overabundance of mathematics becomes accountable for de-motivating some of the students entering such courses. The curriculum planners should bear in mind this limitation and should plan the curriculum such that mathematics should not become responsible for scholastic failure in physics. In addition, in order to relate physics with day-to-day life, some extra courses such as astronomy, geophysics, biophysics, and environmental physics should be added to the curriculum.

3.4. Factors controlled by teaching methodology
Factors controlled by teaching methodology are important and more amenable to alteration. These have an imperative influence on student’s attitudes towards physics. Some of these factors have been listed in Table 4. As is observed from the results, students want some changes in the teaching methodology followed by their teachers.

3.4.1. Proposal by the students
On being asked for suggestions to make physics more interesting, some of the typical and frequently expressed comments by students are summarized below:
1. There should be more experimental work rather than cramming derivations and formulae.
2. Teacher’s should keep student’s level in mind
3. Models and videos should be used to make physics more interesting
4. Syllabus seems to be a burden
5. Lack of availability of specific textbooks
6. Need for practical training at other renowned institutes
7. Exposure to seminars and workshops
8. Emphasis on imagination in acquiring knowledge of physics is a drawback
9. Reduction in mathematical content is required

Physics is truly an academic course that requires a lot of critical thinking and ability to solve complex problems. With the aid of demonstrations and practicals it becomes easy to make students understand most of the topics which are generally abstract. Indeed, perhaps a variety of teaching modes may itself engender a positive attitude to the subject (Johnson et al.1997). Results also indicate that most of the students feel that research carried out by the teachers have a beneficial influence on teaching. A potential shortage of teachers is felt at M.Sc. level. The effectiveness of a teacher is measured in terms of student’s achievements. So, we as teachers should develop high level of competence of physics and enthusiasm which can inspire our students. We should possess a good combination of subject knowledge, classroom management, commitment and pedagogic skill to enthuse, excite and educate the students. The teachers should attend in-service training seminars and workshops so as to strengthen their practical knowledge. All physics teachers should feel empowered to undertake small-scale classroom based research to improve their own practice and inspire students.

4. CONCLUSION

Students appear to appreciate the practical work in terms of both enjoyment and its educational efficacy. The less conceptual and more mathematical nature of physics at graduation level, results in negative views about physics, amongst students. The mathematical barrier is too high for many students intending to study physics, thus contributing to high dropout rates and course transference. Hence, there is need of some effective changes in the course curriculum. Student variables are largely outside the direct control of teachers but on the other hand teacher controlled factors are more acquiescent to alteration. Faculty members should find out methods to reach their students and follow practical approach, even if they are really sophisticated in their fields. Active student participation and student -teacher interaction should be increased. Teachers should try to develop discussion based learning ambiance. Our mandate should be to provide our students with successful physics training, to bring up necessary brain power in this current technological era. The more our students learn about physics, the more it will help them everyday, and the better they will understand their place in this universe. We recommend other faculty members to carry out similar surveys in various colleges and universities, and contribute to purge negative notions about physics amongst students and improve physics education.

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REFERENCE