Medical Students' Attitudes Towards Physics

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Objectives

Our aim was to measure medical students' attitudes towards a) physics as a subject, b) physics as useful to medicine, c) the learning environment d) physics textbooks as an efficient teaching device, and e) the assessment process.

Theoretical framework

Medical educators will probably agree that medical students should know the principles of physics to some extent. However, there are different medical school models with regard to the depth of physics students are required to learn. In most American schools, for instance, where medical studies are a graduate program, a one-year college-level course in physics is required during premedical studies. Students are not required to learn physics during their high school studies, nor is physics taught during the medical school years. In many medical schools in Europe, students are required to take a physics course at the high school level, and physics is not included in the medical curriculum. In other medical schools, such as the Technion in Israel—which is an undergraduate program—students are required to take both an advanced-level course at the high school level, before entering medical school, and one and a half years during their medical studies at the university level.

It is widely known that both high school and college students find it difficult to succeed in physics and avoid it because of its reputation as an applied mathematics course (Towes, 1988). Among pupils in England, for instance, physics is perceived as rather an "elite" subject, conceptually very difficult and suitable only for exceptionally able pupils (Woolnought, 1994; Osborne et al., 1998). At the college level, physics has been described by students with aspirations of becoming our future scientists, doctors, and engineers as the "weed-out course," the "flunk-out course," and even the "killer course" (Hewitt, 1990). Why is it that medical students, who are selected based on high standards and who all have the approved prerequisite skills to succeed in their studies (Norman and Schmidt, 2000), regard physics as a "killer"? It is our belief that students' attitudes play an important role in their interest in and motivation to learn rather than their capability to succeed in physics.

Attitudes has a variety of meanings. However, according to Miller (1961), there is general agreement that attitudes are feelings, either for something or against it; that they involve a continuum of acceptance (accept-reject, favorable-unfavorable, positive-negative); that they are held by individuals; that they may be held in common by different individuals; that they are held in varying degrees (there is neither black nor white, only shades of gray between extremes); and that they influence action. Motives and interests are influenced by our attitudes (Miller, 1961). In addition, attitudes towards science classes have been found to be the best predictors of students' intentions to enroll in science classes (Crawley & Black, 1992).

Atwater, Wiggins, and Gardner (1995) found that students with positive attitudes towards science had positive attitudes towards their science teacher, science curriculum, and science-classroom climate; but neutral attitudes towards their science-classroom physical environment and their school. The measurement of students' attitudes towards physics should take into account their attitudes towards the learning environment. It is also known that it is impossible to overestimate the importance of assessment (Newble, 1998). It is our belief that measuring students attitudes' should also take into consideration their attitudes towards the assessment process.

Although many researchers argue that students' attitudes have great impact on their motivation to learn a subject, medical students' attitudes towards physics have not yet been measured. Also, we believe that in order to facilitate students' success in physics, it is important to first hear the "students' voice" and examine their attitudes towards physics.

Methods

Participants

Thirty-two medical students in their fourth year of a six-year undergraduate program, who agreed to participate in this study, anonymously completed the questionnaire. We chose fourth-year medical students because they had just completed the one-and-a-half-year intensive physics course required at the Technion and had already completed all the preclinical courses. They had also had some clinical experiences at the teaching hospital.

Development of "Attitudes Towards Physics" Scale

The instrument was developed by the research team, which consisted a physics educator, a physician, and a medical student. The questionnaire design included the following steps:

1) Clinical interview: The first author conducted interviews with 15 students, who were asked to freely express their feelings towards physics.

2) Domain determination: After reading the literature and the students' statements from the interviews, the authors, based on group discussion, determined five domains in which attitudes were measured: A) views towards physics as a subject, B) physics as useful to medicine, C) the learning environment, D) textbooks as

an efficient teaching device, and E) the assessment process.

3) Preliminary questionnaire: Through several group discussions, the authors composed a set of 29 items answered on a balanced 5-point Likert scale that was labeled from 1 (“strongly disagree”) to 5 (“strongly agree”).

4) Pretest: The questionnaire was handed to 10 third-year and 10 fifth-year medical students. They were asked to comment on the questionnaire with respect to ease of answering, comprehensibility, if there were any irrelevant statements, and whether there were any missing statements.

5) Final questionnaire: We revised the questionnaire according to students comments.

Analysis

Using coded data, a computer-generated spreadsheet working within SPSS for Windows (version 7.5) was used to calculate response frequencies.

Results

The questionnaires were handed in by about half of the students asked to complete them. The average and median of answers rating each variable from 1 to 5 of the Likert scale is shown in Table 1.

The first group of questions (Domain A) was designed to measure students’ attitudes towards physics as a subject. The findings indicate that, overall, students’ attitudes towards physics as a subject are positive (mean = 3.47). Although students do not see physics as the most interesting subject within the science field (mean = 2.38), they believe that learning physics assisted them to understand other scientific domains (mean = 3.94) as well as day-to-day phenomena (mean = 3.66).

The second group of questions (Domain B) was designed to measure students’ attitudes towards the usefulness of physics to medicine. The findings indicate that, overall, students’ attitudes towards the usefulness of physics to medicine are positive (mean = 3.31). They believe that physics assisted them to understand other medical subjects (mean = 3.53), that high school physics is not enough for medical students (mean = 2.25), and that they should learn physics during their medical studies also (mean= 3.53).

The third group of questions (Domain C) was designed to measure students’ attitudes towards the learning environment. Overall, students’ attitudes in this domain was low (mean = 2.84). Laboratory experiments did not assist students to understand the topics learned (mean = 2.56). The lecturer did not make enough of a connection between physics and medical topics (mean = 2.38). The physics lessons were usually not very interesting (mean = 2.19).

The fourth group of questions (Domain D), concerning textbooks as an efficient teaching device, on the one hand revealed positive attitudes towards both the readability and comprehensibility of textbooks (mean =3.22) and the efficiency of illustrations to understand the subject learned (mean = 3.88). On the other hand, students did not feel they needed the textbooks to succeed (mean =1.78).

The fifth group of questions focused on students’ attitudes towards the assessment process. Overall, students’ attitudes were positive (mean = 3.30). The physics tests usually reflected what was learned in the lectures (mean = 3.09), and they believed that usually they deserved their grades in the physics courses. However, they thought that they devoted too much time to homework (mean = 3.13) and preparing for tests (mean = 3.34).

Conclusions

Medical students believe that they should understand basic physics concepts and see physics as an important subject that helps them to understand both everyday phenomena and medical topics. They also were not scared by the physics courses, as one might expect. However, the findings reveal a gap between students’ views regarding the subject of physics itself and the way it is taught. They especially did not feel that the lecturer related physics concepts to medicine, and found the physics lessons usually uninteresting. Surprisingly, in contradiction to researchers’ views of the important role of laboratory experiments in the understanding of science, the medical students in our study did not find the physics laboratory useful. These results indicate that our medical students appreciate physics, but not the way it was taught. It means that the route to students’ enthusiasm for physics is in the educators’ hands. Medical students appreciate physics and even believe that high school level is not enough. Moreover, they believe that they should also learn physics during their medical studies.

Based on these results, we suggest designing and implementing a special physics course with the following characteristics: 1) A “conceptually based” medical curriculum: Educators should develop and implement a conceptually based curriculum that stresses the mastery of key physical concepts relevant to medicine, rather than emphasizing the mathematical component of physics. Support for our point can be found in Tomorrow’s Doctors (General Medical Council, 1993), which advocates a substantial reduction in the burden of factual information imposed on students in undergraduate medical curricula and the promotion of learning through curiosity, the exploration of knowledge, and the critical evaluation of evidence.

2) Integrated course: In traditional medical schools, each discipline looks at the curriculum content from the perspective of its own branch of learning. Little attention is paid to other, or related, subjects that contribute to the curriculum. The underlying assumption of the isolated courses approach is that if humans are equipped with basic physics principles, they

will be able to transfer and apply them to medical situations. However, today, “no one expects broad transfer any longer, but research over the past two [now already three] decades appears to indicate that transfer to analogous problems is more narrow than even the worst pessimist might have feared” (Norman & Schmidt, 1992, p. 560). If we want our students to transfer and apply physical concepts to the medical arena, we should present physics in the context of medical situations and in relation to medical topics. Also, educators should bear in mind that medical students gravitate towards experiences that are related to medicine. Thus, we believe that a physics curriculum that demonstrates physics topics in relation to medical topics will improve students’ attitudes towards physics subjects.

This research was done with a small cohort of students from one traditional medical school. Thus, to check whether these results are general, more students from a variety of medical schools are needed.

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Appendix

Items	Median	Mean	SD
Views towards physics as a subject	*3.31*	*3.47*	*0.67*
1. Each one of the medical students should possess basic physics knowledge. (1)	5	4.66	0.48
2. Physics assisted me to understand other scientific subjects. (2)	4	3.94	1.08
3. Physics doesn't scare me. (4)	4	3.72	1.44
4. I study physics not only because of the university requirements. (6)	3	2.91	1.38
5. Physics is the most interesting subject within the science subjects. (7)	2	2.38	1.24
6. Learning physics assisted me to realize that many everyday phenomena have a physical explanation. (8)	4	3.66	1.10
7. There are not many technical concepts in physics that are difficult to remember. (11)	4	3.88	0.91
8. Physics develops thinking and problem-solving skills. (23)	3	2.66	1.07
Physics as useful to medicine	*3.5*	*3.31*	*0.78*
9. Physics assisted me to understand other medical subjects. (3)	4	3.53	1.29
10. Learning physics during medical studies is important (5)	4	3.53	1.29
11. High-school-level physics is not enough for medical studies.(30)	2	2.25	1.32
The learning environment	*2.89*	*2.84*	*0.62*
12. Lab experiments helped in understanding the lessons efficiently.(10)	2	2.56	1.01
14. Demonstrations usually assisted me to understand the topics learned. (14)	4	4	0.98
15. The lecturer didn't usually devote too much time to explaining the mathematical formulas rather than the physical concepts and the underlying ideas behind them. (15)	2	2.47	1.27
16. The lecturer usually made a connection between physics and medical concepts. (16)	2	2.38	1.07
17. The physics lessons were usually interesting. (17)	2	2.19	1.06
18. The lesson's goals were usually clarified by the lecturers. (18)	2	2.03	0.97
19. The physics lecturer usually used demonstrations to clarify the concepts learned.(19)	4	3.09	1.15
20. I didn't feel belittled by the physics lecturers. (21)	4	3.44	1.08
21. My percentage of participation was usually high in the physics courses. (22)	4	3.41	1.41
Textbooks as an efficient teaching device	*3.33*	*3.44*	*0.51*
22. I needed the physics books to succeed in physics. (9)	1.5	1.78	1.31
23. Physics books are usually easy to read and understand. (12)	3.5	3.22	1.1
24. Drawings and figures in the physics books were usually efficient and assisted in understanding the concepts learned.	4	3.88	0.94
The assessment process	*3.33*	*3.30*	*0.63*
25. It usually took me too much time to prepare the homework. (24)	3.5	3.13	1.18
26. The physics tests usually reflected what was learned in the lessons. (25)	4	3.28	1.14
27. The physics tests usually reflected the level of the lessons. (26)	3.5	3.09	1.20
28. Usually I prepared myself before the lesson. (27)	3	3.13	1.1
29. Usually it took me too much time to prepare myself for the test (28)	4	3.34	1.15
30. Usually I deserved my grades in the physics courses. (29)	4	3.81	1.06