DIFFICULTIES MET BY MEDICAL STUDENTS IN THE COURSE OF BIOPHYSICS: A COMPARATIVE ANALYSIS

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ABSTRACT

The systematical observation on students studying biophysics draws attention on some difficulties, regularly appearing during laboratory exercises. These difficulties could be easily defined as well as split in groups by their origins, which is clearly proven using an appropriate questionnaire technique.

Meeting some requirements arisen in last few years, the educational process in biophysical labs undergoes certain rearrangements. Tracking the distribution of main difficulties met in experimental work and analyzing the students' response one can judge the capability of academic work.

The aim of this pedagogical research is to find out the main difficulties met by the medical students studying biophysics, to retrieve the origins of these difficulties and, if it possible, to suggest some measures concerning their elimination. Furthermore, the presented pedagogical analysis is focused on answering the question: "Which organization of laboratory exercises is most effective?". Thus, we can achieve a substantial growth in quality of education.

Keywords: biophysics, quality of education, pedagogical analysis

INTRODUCTION

Biophysics is among the obligatory preclinical courses during the medical education (2nd term of year I). It consists of lectures as well as practical exercises. In order to increase the efficiency of teaching, students are encouraged to be well acquainted with theory concerning every exercise to go; and also, they should prepare an empty laboratory report in which they fill in the corresponding experimental data.

During 2003/04 and 2004/05 academic years two groups of students (consisted of 28 and 27 peoples, respectively) are studied in order to determine the main difficulties met by the students in their course of biophysics. These two groups were studied identically, offering the students at the end of every particular exercise the same questionnaire set. The only difference between 2003/04 (**Group I**) and 2004/05 (**Group II**) groups was in the set-up of the laboratory work. Whereas students in **Group I** prepare and do the same exercise at a time, **Group II** was divided in two subgroups, each working simultaneously on a separate topic. The last one set-up was provoked by increased number of students per group, which could not be met by the hardware equipment available.

Due to difference of work organization between **Group I** and **Group II**, there are some details that should be mentioned here:

- **Group II** has half a time for checking students' theoretical preparation, compared to **Group I**;

- **Group II** has half a time for assistance in experimental work, compared to **Group I**.

MATERIALS AND METHODS

Pedagogical diagnostics represents "a good empirical analysis which, in some cases, could take experimental forms" [1, p.356]. As a practical activity, the pedagogical diagnostics "is aimed on ... an adequate and expedient use as well as future development in pedagogical practice" of the methods, created by research worker [1, p.357]. One of the most popular methods, widely used in the pedagogical analysis, is the questionnaire [2, p.271].

Reliability of the questionnaire results are usually measured by "agreement rate of the data, collected in number of consequent observations" [2, p.270]. Therefore, in order to avoid the negative influence of some factors on result's reliability, identical conditions for investigation are provided in any stage of the questionnaire research. The questionnaire sets used were the same by the form (written), content (one and the same questions), type (partially standardized) and time distribution (end of the exercise).

Each questionnaire set has the general form as follows:

Major difficulties met

A) In general:

- In theory
- Connection between theory and practice
- In experimental work
- I had no difficulties

e) Other:

B) In particular:

- a) [Answer 1]
- b) [Answer 2]
- c) [Answer 3]
- d) I had no difficulties
- e) Other:

Corresponding to the separate type of the topics studied, every questionnaire set includes different positions in section B): Answers 1-3. Each student of **Group I** and **Group II** was offered to give his answer to the 13 questionnaire sets in the whole course of biophysics (13 experimental exercises provided).

RESULTS AND DISCUSSION

In summary, results concerning the general part (section A) of our questionnaire study are represented in Table 1.

Table 1. Results of questionnaire study in summary (Section A: in general). Answers are given in percents.

Topics	MAJOR DIFFICULTIES A) in general	
	2003/2004 (Group I)	2004/2005 (Group II)
a) in theory	26	32
b) connection between theory and practice	3	5
c) in experimental work	6	11
d) I had no difficulties	64	52
e) other	1	0

Analyzing the results shown, one can draw a set of some important conclusions. At first, it is obvious that regardless of exercise's set-up, approximately half of the students have no difficulties at all. This leads to the conclusion that teaching biophysics is well-organized, well-balanced process, so that suitably prepared students can meet the requirements of experimental exercises. In other hand, it is expected that large number of students (as it is shown – merely 50%) will encounter problems studying physics and biophysics: in their last 2-3 years at secondary school their efforts are usually focused on biology and chemistry (subjects of entrance exam at Medical University) [3].

At second, it is noticeable that the major part of difficulties is connected to the theory of processes. Traditionally, the explanation of that fact assumes problems understanding the mathematical models, vastly used in biophysics. As it is mentioned above, at the secondary school, the mathematics along the physics is neglected by the pupils, which intend to study medicine. Another yet suggestion should be made here: students organize their self-training incorrectly. Before the particular exercise the main student's target is preparation of empty laboratory report. That is intolerable, because consumes a lot of time and, sadly, shifts the aim of teaching from understanding the matter to some technical work. One possible course to solve this problem is to offer students a ready set of empty laboratory reports, which should be filled in with an appropriate data and observations. Such an approach is already accepted by many pre-clinical departments.

In addition, the results shows that minority of students have difficulties with experiment itself as well as the connection between the experiment and theory. Therefore biophysical exercises are chosen in accordance with students' skills and satisfactory explained. Absence of answers of type "e) other" proves that the general part of questionnaire is comprehensively constructed.

However, the most important conclusion should be drawn toward the set-up of exercises. Results presented in Table 1 undoubtedly prove that switching the exercise organization from **Group I** type to **Group II** type leads to the significant decrease of efficiency. Percent of students with no problems falls; percent of students which met difficulties in theory, practice and their connection rises. Such a drawback is somewhat expected: as it has been mentioned already, splitting students in two subgroups (as it was done in **Group II**) reduces the time for assistance and explanation. Though, **Group II** type of organization was set in students' favor. From some years on, number of students per group has been increased. Hardware equipment of biophysical lab cannot meet these changes effectively. In order to involve every particular student directly in experimental work, splitting students into separate teams was a reasonable solution. In such a way, generally speaking, there was given an accent to the practical skills development in return for slight decrease of teaching efficiency.

Results concerning the special part (section B) of our questionnaire study are represented in Table 2.

Table 2. Results of questionnaire study in summary (Section B: in particular). Answers are given in percents.

Topics, classified by meaning	MAJOR DIFFICULTIES B) in particular	
	2003/2004 (Group I)	2004/2005 (Group II)
1. Understanding physical concepts	26	31
2. Working out formulas and solving equations	19	16
3. Constructing and reading graphs	14	16
4. Doing experimental tasks	13	25
5. Working with tables	9	11
6. Other	19	1

Examining these results, one can conclude once more that the major problems met by medical students, studying biophysics, are connected with theory, not practice. However, splitting the students in two teams doubles the number of experimental difficulties. That is, reduced assistance time is definitely insufficient for making students familiar with the physical devices as well as theory of the topic. But theory could be understood using textbooks, while developing an experimental experience – can not. This brightly demonstrates the importance of encouraging students to be engaged in real experimental activities.

Among other particular problems one can outline the work with graphs, tables and scientific calculators. Frequency of these topics remains statistically equal comparing **Group I** and **Group II**. Hence, their origins most likely could be found in some kind of fault in secondary school education. Taking this in account, we propose establishing a separate topic to be included into the course of physics/biophysics course.

In Table 2 appears an unexplained and considerable shift concerning frequency of answer 6 (*other* particular difficulties). The reason could be the different rate of ethnical homogeneity of **Group I** (39% foreign students) and **Group II** (26% foreign students). It is well-known phenomenon of “answers spreading” among the students: giving the same answer when not sure which one to choose.

CONCLUSION

Taking into account gathered results as well as their analysis, one can draw some conclusions concerning main difficulties met by medical students in course of biophysics, their origins and organization of experimental exercises. On this basis, some measures leading to improvement of education could also be proposed.

1. Reproducibility of results obtained during two different years from two different group of students clearly

shows the persistence of problems observed as well as the adequacy of questionnaire sets used;

2. Major part of difficulties is assigned to the theory of biophysics. Instead of making their own laboratory reports, students should be offered ready (but empty) ones, including questions concerning each separate topic, thus encouraging them to understand the root of the matter being studied. Moreover, it should be kept in mind that involving students in theoretical work is not an easy task due to their negative response;
3. It is firmly demonstrated that on-line assistance is essential not for development of theoretical knowledge, but for gaining practical experience. This should underline the importance of keeping the number of students per group relatively small – corresponding to the hardware equipment available. Unfortunately, it is seldom in capability of the department to organize details of that matter. However, it should be kept in mind that involving students in experimental work is a rewarding task (positive response);
4. Special attention needs the fact that medical student often do have problems with some routine tasks (working with graphs, tables, calculators). Such a simple obstacle could dramatically decelerate work and shifts students’ attention away from the main goal. Introducing an appropriate training into the course of physics/biophysics/chemistry should be in help.

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