

Students' Attitude to Application of Information Technologies in Biochemistry Education

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Abstract: *Correspondent and regular Medical University students' attitude to the interactive multimedia Web-based Biochemistry course is definitely positive. The studies were carried out by means of printed questionnaires with positive and negative suggested answers to get the students' opinion on the usefulness of lectures, tests and clinical case simulations (CCS), and on Web-based distance learning. A pilot study using 6-degree scale also showed that learning by CCS was highly estimated. Using CCS facilitates long lasting retaining of information by students.*

Key words: *Medical Education, Biochemistry, Web-based learning, students' attitude, course-support system, lectures, tests, clinical case simulations, dynamic database.*

INTRODUCTION

The necessity to keep up with quick development of information technologies and financial considerations are important reasons, for which Bulgarian Universities prefer to develop own course support systems (CSS) instead of buying or licensing foreign ones [1-3, 5-9, 14]. Such are ARCADE of the University of Sofia [1-3], eLSe of the University of Rousse [6, 8, 9, 14], the Virtual University of Plovdiv [5], etc. The Medical University – Sofia (MUS) also has developed two CSS of organizing and managing of Web-based problem-solving oriented learning: a JavaScript-HTML system with the support of the Medical Science Council [10] and a PHP-based CSS with the support of Open Society Foundation – Sofia [4, 11-13]. The last system is one of the three different tiers of a Linux server where it interacts with Apache Web-server and MySQL database. The application is developed by Netage Solutions, Inc according to the conception, requirements and specifications of the Medical University – Sofia (project “Developing Educational Web-based Medical Software”) [11] and following the algorithms of the specific system modules (e.g. see [4, 13]. The problem-solving oriented multimedia course “Interactive Biochemistry – Sofia”, created by the system and used to test the system, is seen at <http://biochemistry.orbitel.bg> (2002). The modules for the students allow using of lectures, interactive tests, clinical case simulations and supplementary materials. Searching, registration and administrative module for the teachers to create and edit teaching materials are other useful options.

Talks and interviews during regular studies with students from MUS showed that they take vivid interest and have favorable attitude to Web-based learning (WBL). For more objective evaluation, initial studies were carried out with correspondent and regular students, as well as with some teachers during the academic year and after the examinations. The questionnaires contained multiple-response questions with positive and negative suggestions about students' attitude to different parts of the course and WBL as a whole. More than one answer could be chosen, best corresponding to their opinion. In another pilot study a six-point scale was used to express approval or disapproval.

OPINION OF CORRESPONDENT STUDENTS

The opinion of correspondent students is of special interest as the course is of greatest use to them. The studies include the whole fifth year class pharmaceutical correspondent students for the academic year 2001/2002 (n = 32). 97% of the class are female and 3% are male. 33% live in Sofia, the rest are from the country. The distribution according to age is as follows: 24% are up to 25, 61% are in the range of 25–30, 6% are in the range of 31-35, 6% are in the range of 36-40, and 3% gave no answer. The access to

Internet is as follows: 33% have their own computer, 18% have a computer in their office, 27% can use a computer of friends, 18% use a computer in Internet clubs, 3% have no access to Internet.

The results confirmed the expectations of positive social effect. Different parts of the Biochemistry course were demonstrated to them during the small number of compulsory lectures. All of them expressed their wish to use the course and the distribution of the answers is as follows: 52 % wanted to use the whole course, 30% - mainly because the lectures are not available in textbooks, 27% - because of the colored illustrations and animations, 3% - because of the useful links to external sites, 27% because of the possibility of self-evaluation by means of interactive tests and clinical case simulations.

After the examination was over, another study was carried out about their opinion on the usefulness of the three main course parts (table 1). The sum of answers is higher than 100% because more than one answer could be chosen. In all questions the sum of the positive answers is high – between 97 and 133%. The sum of the negative answers is between 0 and 3%. No negative answers were chosen in questions 1 and 3, concerning the usefulness of lectures and CCS, respectively. In question 2, concerning the usefulness of the tests, the negative answers are only 3%.

Table 1. *Opinion of the correspondent pharmaceutical students in MUS, fifth year, about the usefulness of the Web-based course in Biochemistry*

A – results in % of all inquired. Sum (+) – sum of the positive answers; Sum (-) – sum of the negative answers.

| Question and suggested answers | A% |
|--|-----------|
| 1. Were the Web-based lectures useful to you? | |
| 1) I have not used them | 17 |
| 2) Yes, because they are short, clear and excellently illustrated | 53 |
| 3) No, they are too long, unclear, with complex illustrations | 0 |
| 4) Yes, because they contain novelties not available in textbooks | 43 |
| 5) Yes, because they fully correspond to the syllabus and because of the directions for self-study | 37 |
| 6) No, I think they are useless | 0 |
| Sum(+) = 133%; Sum (-) = 0% | |
| 2. Were the Web-based tests useful to you? | |
| 1) I have not used them | 20 |
| 2) Yes, because of the possibility of self-evaluation | 60 |
| 3) No, because the questions are not clear | 3 |
| 4) Yes, because of the opportunity to create associations between different questions | 17 |
| 5) No, I think they are useless | 0 |
| 6) Yes, because the questions are clearly formulated and help me understand Biochemistry better | 20 |
| Sum(+) = 97%; Sum (-) = 0% | |
| 3. Were the Web-based clinical case simulations useful to you? | |
| 1) I have not used them | 20 |
| 2) Yes, because I see the application of Biochemistry in the clinical practice | 47 |
| 3) Yes and I recommend to develop cases from pharmaceutical practice | 20 |
| 4) No | 0 |
| 5) No, I think they are useless | 0 |
| 6) Yes, because they are interesting and stimulate not only memorizing but thinking too | 30 |
| Sum (+) = 97%; Sum (-) = 0% | |

In a similar way some other aspects of the students' attitude towards distance learning were studied. 77% would like to carry out a post-graduate qualification by means of Web-based learning, 23% were not certain but no negative answers were chosen. 80% would like to use such courses in other disciplines, 20% were not certain, but again no negative answers were chosen.

If Web-based distance learning would be implemented legally in all disciplines, the expenses for accommodation, transport, etc. during the obligatory classes would be reduced by 10-15% for students living in Sofia and by 20-250% for students living in the country.

Beyond the financial aspect, most of the students prefer Web-based learning (WBL) instead of obligatory classes, which according to them could be considerably reduced or replaced. The sum of positive answers is 178% against 9% negative answers. The positive answers are distributed as follows: 15% believe that WBL can fully replace the compulsory classes, 45% think that WBL can considerably reduce the time for them; 49% think that getting acquainted with the course before these classes would be most useful and that only difficult questions could be discussed there; 30% prefer that, in case of unclear questions, first to have e-mail correspondence with their teacher and only as a last resort to have compulsory classes; 39% think that it is much more convenient for the student to study at home, not separating from family.

OPINION OF REGULAR MEDICAL STUDENTS AND THEIR BIOCHEMISTRY TEACHERS

Similar is the opinion of regular medical students (n=30) towards the Web-based course, and teachers – assistant-professors of Biochemistry (n = 8), carrying out practicals (table 2). The answers of students and teachers are definitely positive. The students have chosen only one answer, therefore the sum is equal to 100%. Most of the teachers have chosen more than one answer, therefore the sum of answers is above 100%

Both groups find the programs very useful and insist that it is necessary to provide more computers. It should be underlined that no negative answers have been given to the first and the second questions, and to the third and fourth the percentage is minimum. Interesting are the differences, concerning the fourth question about the distance learning via Internet. The students (100%) are delighted by the opportunity for distance self-study. Most of the teachers (70%) consider that education via Internet is useful because of the novelties not available in the textbooks and only 15 % have chosen the answer given by the students. Other 15 % remain faithful to traditional education.

To clarify the attitude of the medical students (n=245) about the usability of the clinical case simulations (CCS), a set of suggested answers was prepared, so that they could choose those which fitted best to their opinion (table 3). The results are fully positive: 75 % consider that running of CCS is very useful as a training for their future activity. Only 2% think that this is a waste of time. 24% from the students perceive the situation of a specific case as a real one and feel concerned about the patient. 44 % like the possibility to be active participants in solving the case instead of passive observers. For 37% it is important that if they make a mistake, there will be no harm to a real patient. 62% are convinced that Biochemistry and clinical practice are related. 48% are aware that without knowledge of the basic biochemical pathways, they would not be able to solve clinical cases. 42% answer that solving such cases motivates them for serious and in-depth-study of Biochemistry.

The assistant-professors of Biochemistry and other medical disciplines in the Medical University – Sofia have no special computer skills as designers and program developers. They are unanimous that the administrative module of the PHP-based course

support system allows them to create Web-based courses with no difficulties, despite of the lack of such skills.

Table. 2. Attitude of regular medical students (A) and teachers (B) towards distance learning and the Web-based Biochemistry course. Sum (+) – sum of the positive answers; Sum (-) – sum of the negative answers in %.

| Question and suggested answers | A % | B % |
|--|--------|--------|
| 1. Are the illustrations in the lectures useful? | | |
| 1) Yes, I think that they facilitate learning and are better than black-white ones in the available text-books | 18 | 69 |
| 2) No | 0 | 0 |
| 3) Yes but I prefer to find a computer in each hall | 82 | 85 |
| 4) Other comments or recommendations | 0 | 0 |
| 2. Are the interactive tests useful when studying for current midterm examinations? | | |
| 1) Yes, very good for quick assessment and self-assessment of knowledge | 64 | 62 |
| 2) No, I prefer the written version of tests | 0 | 8 |
| 3) Yes but I prefer to find a computer in each hall | 36 | 77 |
| 4) Other comments or recommendations | 0 | 0 |
| 3. Are the interactive clinical case simulations useful? | | |
| 1) Yes, they show the link between the Biochemical theory and clinical practice | 27 | 62 |
| 2) No | 9 | 8 |
| 3) Yes but I prefer to find a computer in each hall | 64 | 77 |
| 4) Other comments or recommendations | 0 | 0 |
| 4. How do you evaluate the opportunities for distance learning via Internet? | | |
| 1) I am delighted by the opportunity for distance self-study | 100 | 15 |
| 2) No, I prefer traditional learning | 0 | 15 |
| 3) Yes but I prefer to find a computer in each hall | 0 | 0 |
| 4) Yes, it is very useful because of the novelties not found in available textbooks | 0 | 69 |

Table 3. Attitude of medical students (n = 245) towards the clinical case simulations

| Suggested answers | Chosen answers % |
|---|------------------------|
| 1) Running of CCS is very useful as a training for their future activity. | 75 |
| 2) Running of CCS is a waste of time. | 2 |
| 3) I perceive the situation of a specific case as a real one and feel concerned about the patient. | 24 |
| 4) I like the possibility to be an active participant in solving the case instead of a passive observer. | 44 |
| 5) Even if I make a mistake, there will be no harm to a real patient. | 37 |
| 6) If I make a mistake, my teacher will not understand. | 7 |
| 7) Running of CCS convinces me that Biochemistry and clinical practice are closely related. | 62 |
| 8) Running CCS makes me aware that without knowledge of the basic biochemical pathways, it is not possible to solve clinical cases. | 48 |
| 9) Solving of clinical cases motivates me for a serious and in-depth-study of Biochemistry. | 42 |

Another pilot quantitative study on the attitude of the students (n=60) towards the Web-based clinical case simulations, used a six point scale, 1 meaning strong disapproval, 6 meaning strong approval (table 4). The mean value of 5.575 speaks well for CCS and is a stimulus for us to prepare new scenarios for Web based simulations. It is interesting that students from higher classes, approving learning by CCS, have participated in preparation of some scenarios as co-authors.

Table 4. *Quantitative pilot study of students' attitude towards clinical case simulations by means of a 6-point scale, in which 1 means strong disapproval, 6 means strong approval, n = 60.*

| | | | | | | |
|------------------------------------|----------|----------|----------|----------|----------|----------|
| Grade | 6 | 5 | 4 | 3 | 2 | 1 |
| Number of grades | 43 | 14 | 1 | 2 | 0 | 0 |
| Mean grade: 5. 575 (n = 60) | | | | | | |

LONG LASTING MEMORY AND CLINICAL CASE SIMULATIONS

Table 5 presents data about the positive effect of CCS on learning. A long lasting experiment was carried out. The whole course was divided into comparatively equal groups. The first one (128 students) had sessions on solving clinical cases in the middle of the first term. The cases were in the fields of carbohydrate metabolism. The other group (148 students) followed the traditional curriculum without solving clinical cases. About ten months later at the end of the second term, immediately after the formal oral examination in Biochemistry all students answered questions on carbohydrate metabolism. The answers of the first group were as follows: 72% correct and 28% wrong answers. In the second (traditional) group the correct answers were 47 % (against 53% wrong answers). The results show that the probability the information to be retained in the long lasting memory is increased after running CCS.

Table 5. *Effect of solving clinical cases on long term memorizing. In the experimental group the students (n=128) have solved clinical cases. In the control group the students have been taught by traditional lectures.*

| Number of answers | Experimental group (n = 128) | Control group (n=148) |
|--------------------------|---|----------------------------------|
| Correct answers in % | 72 | 47 |
| Wrong answers in % | 28 | 53 |

CONCLUSIONS AND FUTURE WORK

The positive attitude of the students in the Medical University – Sofia to the application of information technologies in the Biochemistry education stimulates the constant renovation and improvement of the Web-based Biochemistry course and the conversion of the course support system into a university portal for distance learning in different disciplines.

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