

Articles

Adapting a Biochemistry Course to Distance Education

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Internet-based distance education seems to be an attractive alternative to offer courses dealing with specific topics that are not conveniently explored in undergraduate courses. This is a good way to provide access to the recent and updated discoveries in this research area and to reach people who could not take the classes in the traditional mode. Using the communication advantages available via the Internet, we adapted the course “Biochemistry of Nutrition,” first offered as a summer course to be entirely carried out at distance. The adaptation explored the use of online tools such as E-mail communication among students and teachers, computer conferencing in small groups to discuss specific subjects, and texts and software downloads to be used as main references. Graduate students had their first real experience as teachers, which proved to be very productive for both the development of the Internet version of the course and their integration with undergraduate students.

Keywords: Nutritional biochemistry, Internet, distance education, collaborative learning.

The Functional and Molecular Biology graduate program at State University of Campinas and the Biochemistry graduate program at University of São Paulo have offered to their graduate students the opportunity to develop and teach summer courses to undergraduate students as a part of their pedagogical training [1]. The pedagogical training is divided into two parts: 1) planning phase, where graduate students select the subject, plan the curriculum, and design the classes and pedagogical strategies; and 2) teaching phase, where graduate students deliver the courses to an undergraduate audience.

The courses have some peculiar characteristics: high diversity of pedagogical strategies; 1-wk course with 30 h classroom instruction; great demand by undergraduate students; multi-disciplinary; and contents not taught in the regular face-to-face courses.

Nutritional biochemistry was the subject of the 1998 summer course. The large number of registered students to the “Biochemistry of Nutrition” course and its excellent student evaluation of the course were the reasons for creating a distance education course.

The course objectives, content, and evaluation tools were completely restructured to fit the Internet-based resources and to allow more students to enroll. The Internet version of this course was structured as a regular 15-wk course and offered in the Fall of 2000 and Spring of 2001 and 2003.

The online tools used were E-mail communication among students and teachers; computer conferencing in small groups through discussion of specific topic; and

texts and software downloads used as instructional aids.

The participation of graduate students as teachers was a feature of the Internet-based course, because the integration between graduate and undergraduate students has been shown to be very productive for both parts. The intention of giving close and prompt support to the students enrolled in the course made it also necessary to have a reasonable number of tutors available.

ACTIVITIES AND CHANGES IN THE DISTANCE EDUCATION FORMAT

There are many reports about using Internet resources to complement traditional biochemistry classes [2–5]. Actually, the Internet is such an endless information source, and the topics chosen for this course, such as weight-loss diets, free radicals, caloric intake calculations, specially prescribed regimen, malnutrition, and obesity, can be easily found on the Web.

The course was essentially structured as a Web page where the students and the teachers could access texts, exercises, educational software [6], and communication tools such as discussion lists and chat rooms.

One topic per week was available for download, and each one was carried out by different activities: problems and exercises, chats, and computer-assisted conferences or discussion lists. Table I presents the themes taught in the original course and the activities developed to adapt the course for distance education.

In the original course, all activities were supported by questions to guide students and by 10 graduate students circulating in the classroom to answer the undergraduate students' questions. At the end of each day, teachers asked a question about the content studied during that day

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TABLE I
The "Biochemistry of Nutrition" syllabus for the original course (1998) and the distance education course (2000–2001)

Topic	Activity in the original course	Activity in the distance education course
Nutrition through the years	Lecture to introduce the course and to show the importance of research about nutritional biochemistry.	Text download and study guide about the first discoveries about vitamins. Doubts and questions were posted to the discussion list.
Macro nutrients metabolism review	Study guide-based discussion in small groups, with teacher facilitation.	Text download and study guide about the metabolism. Doubts and questions were posted to the discussion list.
Determinations of differences in glucose, urea, cholesterol, and triglycerides blood levels in different diets	Discussion about differences in glucose, cholesterol, urea, and triglycerides blood levels taken from volunteer students before and after a day diet. The volunteers gave priority to carbohydrate, lipid, or protein in their diets of one day.	Text download and a study guide about clinical correlations of alterations in glucose, urea, cholesterol, and triglycerides blood levels. Doubts and questions were posted to the discussion list.
Calculation of the caloric intake	Study in small groups to calculate the caloric intake produced by different kinds of meals.	Text download and a study guide about caloric intake calculation. Doubts and questions were posted to the discussion list.
Calculation of individual nutrition parameters	Determination of individual nutrition parameters using the formula of body mass index (BMI) and basal metabolic tax (BMT), and results comparison to the individual caloric intake.	Plan a day diet to a course colleague, based on the BMI, BMT, and caloric intake calculated data. Post the proposed diet to the discussion list.
Free radicals and orthomolecular medicine	Study of an educational software [6] to introduce the topic free radicals. Seminar "The Orthomolecular Medicine" presented by an invited speaker.	Download of the free radical software and the study guide. Doubts and questions were posted to the discussion list.
Food preparation and bioavailability	Lecture about competition of different components in the organism to the same receptor, as well as the loss of some minerals according to the management of the food.	Download of a text and a study guide about the bioavailability and the consequences of different ways to prepare the food. Doubts and questions were posted to the discussion list.
Sugar levels in different kinds of drink	Laboratory experiments to quantify the sugar levels in different kinds of drinks. Differentiation between light and diet drinks in details.	Download of a text and a study guide about the differences in diet and light foods and about phenylketonuria. Doubts and questions were posted to the discussion list.
Post-harvest physiology	Laboratory class and discussion about post-harvest manipulation of fruits and vegetables.	Home-made experiments about post-harvest manipulation of fruits and vegetables followed by online discussion in chat rooms.
Malnutrition	Metabolic and social aspects of Kwashiorkor and marasmus diseases. All students discussed the topic in class, giving answers and opinions to questions and to additional information proposed by the teachers.	Discussion (assisted and non-assisted) in chat rooms about the metabolic implications in people with Kwashiorkor and marasmus diseases.
Obesity	Study in small groups about the different mechanisms proposed to explain obesity: insulin resistance, leptin, low levels of lipid oxidation, and thermogenesis disturbances. One teacher accompanied each group. New groups were formed with one member from each previous group that explained to the others the mechanism studied.	First activity ^a : four simultaneous discussions in chat rooms dealing with four different theories proposed to explain obesity. Second activity ^b : discussions in chat rooms about the four mechanisms studied before. The discussion group was formed with one component of each previous discussion group.
Weight loss regimens	Presentation and discussion in groups about weight loss programs. New groups were formed with one member from each group discussing a specific regimen program.	First activity ^a : simultaneous discussions in chat rooms each one about one of four specific weight-loss diet. Second activity ^b : discussions in chat rooms about the four weight-loss diets with components from each previous discussion groups.
Specially prescribed regimens	Discussion in small groups about special diets in a disease situation. Presentation of the metabolic disturbances promoted by a specific disease and general discussion about the specially prescribed regimens for each situation.	First activity ^a : simultaneous discussions about specific diet for a disease in chat rooms. Second activity ^b : discussions in chat rooms about all diets with one member from each previous discussion group.

^a Not required activity.

^b Activity used for learning assessment.

as part of an evaluation process. Students discussed the question in groups and provided one answer per group.

In the distance education course, students were encouraged to reply to other student's questions using the online discussion forum. Teachers helped students by sending references, giving tips, and stimulating them to discuss the topics through the online discussion forum. All activities done during the course (exercises, chats, and the final test) were part of the assessment tools for the course.

COURSE EVALUATION BY STUDENTS AND TEACHERS

Results from the evaluations conducted during and at the end of the course indicated that the use of the Internet resources was exciting for students and teachers. The positive aspects of this experience and the interest by people from different Brazilian states [7] showed that courses taught at a distance have great potential. Comments from students, before and after the course, and from the instructors about the teaching experience are presented below:

Typical Students' Comments Before Taking the Course

"My expectations are very good. The topic is very interesting and I think that the use of Internet is exciting."

"I hope this distance course will increase my knowledge both in Nutritional Biochemistry and computing, which could not be achieved in traditional courses."

Typical Students' Comments After the Course

"The course surpassed my expectations. At the beginning I thought it would be very easy! Then I realized that we (the students) had many tasks to complete . . . it was even more difficult compared with a traditional course."

"My questions about the topics appear only when I study at home. In a distance course we can just ask questions via E-mail to the teacher and always get an answer."

"I would like to express my satisfaction for have being part of this course. The content was interesting and the strategies very efficient, besides being very exciting (. . .) The flexibility and the tools of the Internet course made it possible to conciliate my professional and personal life with course schedule."

"I really appreciated the course. It was my first experience in distance course and I am now encouraged to look for other Internet-based courses."

Typical Teachers (Graduate Students) Comment

"In a traditional course the students don't have much room to discuss their misconceptions with the teachers. In a distance education course, students feel more comfortable to send their questions via E-mail, and the interaction among teachers and students is improved. It also encourages us to update our knowledge to better assist students and answer their questions."

DISCUSSION

The Internet is certainly an excellent media to offer courses to improve and update biochemistry knowledge because it is a great source of information, and presents different and efficient communication tools. The possibility

to use E-mail discussion lists and chat rooms for discussions to increase the interaction among the participants was one of the main reasons for the good acceptance of the course.

The structure of the course, based on interaction among students through the Internet communication tools, is appropriate for the student-centered learning model, in which the teacher does not simply give the answers to the students' questions, but must also stimulate discussion and critical thinking. In the "Biochemistry of Nutrition" course, students at various performance levels work together in small groups toward a common goal. The peer teaching process with the students being responsible for the colleagues' learning is called "collaborative learning," and the achievement of one student helps other students to succeed [8].

We believe that collaborative learning is only possible through the establishment of a learning community. Simply providing a physical or electronic connection between people or delivering the contents of the course in the Internet do not guarantee that any collaborative learning will take place. It is also important to consider that this model of instruction depends on a lot of students' commitment to the learning, their engagement in the cooperative pursuit of knowledge, and the transition of the instructor's role from authority source of information to facilitator and resource guide.

CONCLUSIONS

The experience of designing and delivering the distance education course "Biochemistry of Nutrition" showed that it is possible to develop a distance education course with the purpose of enhancing and updating biochemistry knowledge. The adequate use of the Internet communication tools in this course was efficient enough to meet the teaching-learning process requirements of students and teachers involved in this work.

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REFERENCES

- [1] D. V. Macedo, E. de Paula, B. B. Torres (1999) Training graduate students to be teachers, *Braz. J. Med. Bio. Res.* **32**, 1457–1465.
- [2] T. S. Ingebritsen, J. Cheaney (1998) Teaching biotechnology via the World Wide Web, *FASEB J.* **12**, 153 Suppl. S APR 24.
- [3] G. R. Parslow, E. J. Wood, B. Livett (1998) Miscellaneous Bytes, *Biochem. Educ.* **26**, 44–49.
- [4] T. Hamamoto, Y. Kagawa (1998) Internet assisted learning of biochemistry in Japan. *Biochem. Educ.* **26**, 7–29.
- [5] J. P. Whitehead, H. E. Pence (2002) Using computer to teach biochemistry, *Biochem. Mol. Biol. Educ.* **30**, 206–207.
- [6] D. K. Yokaichiya, E. Galembek, B. B. Torres (2000) Radicais Livres de Oxigênio—Um Software Introdutório, *Quím. Nova.* **23**, 267–269.
- [7] D. K. Yokaichiya, E. Galembek, B. B. Torres (2001) Expectations and interest in distance education in biochemistry classes, *Revista Brasileira de Ensino de Bioquímica e Biologia Molecular*, www.sbbq.org.br/revista/.
- [8] A. A. Gokhale (1995) Collaborative learning enhances critical thinking, *J. Tech. Educ.* **7**, 22–30.