CIRUGÍA ESPAÑOLA

Original article

Application of new technologies to the teaching of surgery in the school of medicine

Miguel Ángel García Ureña,[a,]* *Luis Miguel Marín Gómez,*[b] *Vicente Vega Ruiz,*[b] *and Antonio Díaz Godoy*[b]

[a]*Hospital del Henares, Madrid, Spain*
[b]*Hospital Universitario Puerto Real, Cádiz, Spain*

ARTICLE INFORMATION

A B S T R A C T

Introduction: The new methods of teaching, based on new technologies, already available in other educational and professional fields are gradually being introduced in our medical schools. The aim of our study is to present our initial experience in the introduction of a subject on the principles of surgery in our university.

Material and methods: The subject was offered voluntary to undergraduate students, with a maximum of 65 students per course during 2 consecutive academic years, while maintaining the traditional teaching with a formal lecture program with a different lecturer. The subject was designed with 60% virtuality on a WebCT platform and later in Moodle. The virtual subject was structured into teaching units, academically directed activities, and communication tools. The subject was assessed in a report prepared by Cadiz University Department of Evaluation and Quality.

Results: There were 32 students in the 2005-2006 course and 62 in the following course. The mean activity of the students was: 602 accesses, 13 subjects for discussion forums, and 20 e-mails between students and teachers. The students who participated in the virtual subject have remarked that virtualisation make it more attractive and is an aid in the acquisition of knowledge. The data obtained from the report showed better results than the mean obtained in other subjects of the Department, School of Medicine and Cadiz University.

Conclusions: The virtual subject of principles of surgery has been well evaluated in our university campus. We believe that the provision of teaching tools and new communication models make an effective contribution to the teaching of surgery as a subject in the school of medicine curriculum.

*Author for correspondence.
 E-mail address: mgarciau@meditex.es (M.A. García Ureña).

Aplicación de las nuevas tecnologías en la enseñanza de la cirugía en la licenciatura de medicina

R E S U M E N

Palabras clave:
Cirugía
Pregrado
Enseñanza
Enseñanza electrónicas

Introducción: Los nuevos métodos de enseñanza, basados en las nuevas tecnologías, ya adoptados en otros ámbitos educativos y profesionales, se van introduciendo progresivamente en las facultades de medicina. El objetivo de nuestro estudio es presentar nuestra experiencia inicial en la implantación de una asignatura de carácter semipresencial de fundamentos de cirugía.

Material y métodos: La asignatura se ha ofrecido con carácter voluntario a los estudiantes, y mantiene el grupo de enseñanza tradicional con un profesor responsable distinto. La asignatura se planificó con un porcentaje de virtualidad del 60% en la plataforma virtual WebCT y, posteriormente, en la plataforma Moodle. La asignatura virtual se estructuró en unidades temáticas, actividades académicamente dirigidas y herramientas de comunicación. En la valoración de la asignatura se presentan los informes realizados por la Unidad de Calidad de la Universidad de Cádiz (UCA).

Resultados: Se matricularon 32 alumnos en el curso 2005–2006 y 62 alumnos en el siguiente curso. El promedio de actividad en el aula virtual por alumno fue: 602 accesos, 13 temas de discusión propuestos en los foros y 20 correos intercambiados entre alumnos y profesores. Los alumnos que han cursado la asignatura han señalado que la virtualización de la asignatura la convierte en más atractiva y contribuye a la adquisición de conocimientos. Los datos del informe sobre la docencia han sido mejores que la media del departamento, la facultad de medicina y la UCA.

Conclusiones: La asignatura virtual de fundamentos de cirugía ha sido muy bien valorada dentro de nuestro ámbito universitario. Pensamos que las herramientas docentes ofrecidas y los nuevos modelos de comunicación contribuyen eficazmente a la enseñanza de la cirugía como disciplina dentro de la licenciatura de medicina.

Introduction

The fact that the application of new information technologies in the teaching of medicine will improve the quality of learning is generally accepted.[1] The use of the term "virtual classroom" is spreading through our universities to label this type of teaching. After several years of using these new study tools there is a good amount of existing literature that analyses its use and the teaching results obtained. However, some authors do not agree that this type of teaching is better than the classic type that we all know.[2]

The Virtual Classroom of the University of Cádiz (UCA) launched this type of teaching 8 years ago in order to support and complement classical theoretical teaching. They later began to offer certain elective courses within the framework of the virtual classroom. After the 2004-2005 school year the doors were opened for core courses. This was the moment that we designed a course for the Basic Surgery course, a course that is given in the third year of the Medicine degree. Said course has been in this format since then. In this study we would like to present our initial experience concerning the design and results of this part-time semi-distance teaching model within the UCA.

Material and methods

The Virtual Classroom of the UCA is a Web environment that is currently regulated by the Vice-chancellor office of Teaching Innovation. This organism offers education programmes to the faculty and regulates all of the activities that are offered in this setting: from space for uploading teaching-supporting material to the possibility to participate in part-time semi-distance courses. These courses must be approved and renovated each school year by a committee of experts. The course was approved by the Council of the Department, and the Vice-chancellor office of Academic Development of the UCA insisted that the Surgery Department must maintain usual full-time on-site teaching. Therefore, the course was offered on a voluntary basis to interested students. On the one hand, there was a group of students that was taking the course in the usual full-time on-site manner with the respective lecturer and, on the other hand, a group of students were taking the course in the part-time semi-distance manner by means of the virtual classroom, with a different lecturer. In the first academic school year of this part-time course, a pilot experiment was carried out with 10 students, and in the

Table 1 – Subject matter included in the course curriculum

Subjects
Historical, social, and practical perspective of surgery
Injuries: biological scarring process. Local response to aggression. Study and treatment of injuries. Injuries from firearms, sharp instruments, bull horns and animal bites
Traumas by physical agents I: burns, freezing
Traumas by physical agents II: injuries produced by electricity, ionizing radiations, and thermonuclear devices
The poly-trauma patient. Fat embolism and air embolism
Trauma by blast or by terrorist attacks. Crush syndrome
Preoperatory. Surgical indication. Surgical intervention
The metabolic response to the surgical aggression
The infection: asepsis and antisepsis. Local infections. Infection and antibiotic therapy in surgery. Necrotising infections. Tetanus
Shock, sepsis, and multiorgan failure
Nutrition and surgery
Surgical complications
Surgical semiology. Semiology of the vascular system
Semiology of the nervous and musculoskeletal systems
Laparoscopy: basics of minimally invasive surgery
Immunity and Surgery. Organ transplants

Table 2 – Part-time semi-distance core courses offered at the University of Cádiz during the academic year of 2007-2008

Course	Faculty	Virtuality, %
Basics of surgery	Medicine	60
Spanish morphology	Philosophy and arts	35
Statistic methods of engineering	Engineering school	50
Functions of the human body	Nursing	75
Mathematics	Social sciences	30
Basic operations of liquid flow and the transmission of heat	Faculty of sciences	70
Basic separating operations	Faculty of sciences	70

next 2 years a maximum of 65 students was admitted per academic year.

The software platform used in the first 2 years was the WebCT. In the 2006-2007 academic year, a migration was carried out to the free Moodle programme, but a similar design was maintained.[3] The course was structured maintaining the same credits as the on-site course: 2.5 theory credits and 2 laboratory credits. The theory credits were structured in the form of 2 hour long classes and seminars every 15 days during the academic year. The internal structure of the programme was organized in different areas, namely: subject matter, activities, communication, audiovisual resources, references, and sources of information and evaluation.

The load of theory credits within the virtual course was divided into the theory units that are numbered in Table 1. Each unit included the topic offered in pdf format, a questionnaire of multiple-choice questions, and an area of links to different resources, such as review articles, relevant articles, or contrasted Web pages, related with the relative topic.

Three activities were proposed as academically directed projects to be carried out during the academic year: the presentation of a clinical case, the critical reading with commentary of a bibliographic source and, in third place, a study evaluating 2 Web pages, one in Spanish and the other in English.

Within the communications plan, an e-mail account was established as a means of communication and contact with the students, with the commitment of the lecturers to respond to the received e-mails in 7 days or less. Various discussion forums were also offered: content and references, activities and projects, exams, labs in the hospital and other issues. Within audiovisual resources, images and outlines of the surgical pathology found in the curriculum of the course were offered. In the last course, a link to a Web page with free

Table 3 – General evaluation of use, tools, and design of the virtual classroom in relation with the learning of the course. Evaluation scale of 0 to 5

Use of the virtual classroom	
It is very useful to study the course	4.4 (0.6)
It has facilitated the acquisition of information	4.3 (0.8)
The course is more interesting	4.6 (0.6)
It contributes to improving my learning	4.3 (0.6)
General evaluation of use	4.4 (0.7)
The tools of the virtual classroom	
I frequently use the tools	3.9 (1)
The use of the tools improves learning	4.3 (0.7)
They facilitate studying the course	4.3 (0.6)
General evaluation of the tools	4.2 (0.8)
The design of the virtual classroom	
No previous technical knowledge is needed	3.7 (1)
Easy access	4.3 (0.8)
It helps to relate the content or concepts of the material	4.3 (0.6)
Its easy-to-use format increases the utility of the course	4.4 (0.5)
Studying with the virtual classroom promotes the participation and interest of the student for the material	4.5 (0.7)
General evaluation of the tools	4.2 (0.8)
Satisfaction with the virtual classroom	
In general, I am satisfied with the studying process by means of the virtual classroom	4.6 (0.6)

access that we developed (www.atlascirugia.es) was fixed. Inside sources and references the students were offered access, by means of the virtual library of the UCA, to full-text books, journals, and important Web pages. A large proportion of these full-text resources are in English.

The exam consisted of answering an on-line questionnaire composed of multiple-choice questions, and questions about a specific clinical case presented with images. All of this, during a maximum time of 60 min. The evaluation was carried out following the following criteria: the exam, 50% of the total value of the grade; the clinical case, 30%; the bibliographic commentary, 10%; and the project carried out regarding the Web page was worth 10%.

The reports carried out by the Evaluation and Quality Unit of the UCA were presented in the evaluation of the course. As the first course was a pilot experiment, it was not included in the evaluation.

Results

The University of Cádiz offers 55 part-time courses. Our course is, at present, one of the 7 part-time core courses offered (Table 2). The course received the Award for the Best Virtual Course of the UCA in the 2004-2005 academic year. In the 2005-2006 academic year 23 students were enrolled and in the 2006-2007 academic year, there were 62 students enrolled. In this current academic year we have reached the highest number with 65 students.

The average amount of activity per student in the course in the last 2 years was as follows: 602 visits, 13 topics of discussion presented in the forums, and 20 e-mails between students and lecturers. On average, the 4 directly involved lecturers of the course responded to an average of 25 messages per week between e-mails and messages in the forums. The results obtained are presented in Table 3 and Table 4 with the surveys carried out by the students for the Evaluation and Quality Unit at the end of the academic courses. With all of this, the general opinion about the course has been a 4.2 on

a scale of 0 to 5. However, the School of Medicine offers, in the students' opinion, a medium accessibility (2.1 [1.2]). The subjective opinion of the students about their participation in the virtual classroom was 4.2. Excluding 4 students who repeat the course this year, the rest of the students passed the course in the first 2 exam sessions.
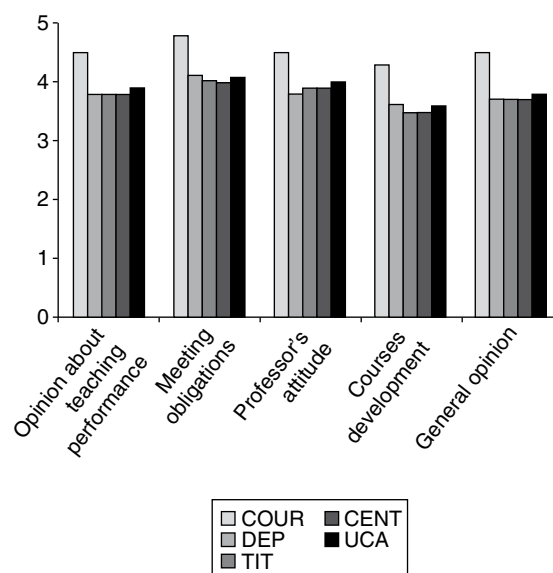

Figure - Diagram of the results obtained from the teaching report when comparing the course with the course averages of the department (DEP), the courses of the medicine degree (TIT), the courses of health science (CENT), and the courses of the University of Cádiz (UCA).

Table 4 – Opinion surveys of the course, its accessibility and the student's self-evaluation. Evaluation scale of 0 to 5	
Opinion about the course	
The curriculum of the course is explained	4.6 (0.5)
The bibliography and the needed material to carry out the course are explained	4.6 (0.6)
There is coordination between the lecturers and what is presented in the virtual classroom	4.2 (0.8)
General evaluation of the course	4.2 (0.8)
Opinion about the accessibility to the virtual classroom	
The centre (department) offers good accessibility	2.1 (1.2)
I have better infrastructure at home	4.7 (1)
General evaluation of accessibility	3.3 (0.6)
Student participation	
I am interested in the course given in the virtual classroom	4.5 (0.8)
I am satisfied with what I have learned in the virtual classroom	4.3 (0.7)
I visit the virtual classroom on a regular basis	4.4 (0.7)
I use the office hours provided in the virtual classroom frequently	3.4 (1.1)
General evaluation of the participation of the student	4.2 (0.9)

Table 5 – Elements included in the teaching report
Opinion about teaching participation
Fulfilment of the obligations
The official schedule of the course is followed
When class is missed, it is justified
He/she is on time to enter and leave the class
He/she complies with the office hours schedule
Lecturer's attitude
He/she is respectful with the student
He/she is accessible and ready to help
Communication with the lecturer is fluid and spontaneous
The lecturer is interested in the student's learning
Development of the classes
The structure of the classes is clear, logical and organized
The resources used during the course are adequate and sufficient
He/she helps to relate the content of the material with other material that has already been covered
He/she responds correctly to the questions presented by students
He/she promotes the participation and interest of the students for the material
General opinion
In general, I am happy with the teaching performance of the lecturer

The report about teaching is collected in Figure elaborated by the Quality Unit of the UCA with the components that are listed in Table 5. The comparative data of the course are presented with respect to the rest of the courses of the department, of the medicine degree and of the UCA itself.

Discussion

The university itself must institutionally coordinate and regulate this type of teaching. Consequently, the Vice-chancellor office of Academic Development and Teaching Innovation is found within the UCA, created as the organism that guides, promotes and coordinates this type of teaching.[4,5] This is fundamental in order to help the students to have the same technical application for the different courses and in different academic years.

Those courses that are attended by means of the computer have the advantage of being more flexible concerning time and space, when compared to traditional courses, where the physical encounter between the lecturer and the student is indispensable. This is especially useful in this geographic area, where students carry out their lab rotations in hospitals located at great distances from the medicine school and separated from each other, which makes the coordination of teaching much more difficult. In addition to this, this type of teaching can palliate the effects of the limited number of lecturers available, especially if the prediction of an increase of students comes true. The students that have taken the course have evaluated the use of the virtual classroom very positively. They claim that the course is very attractive to them and that it contributes not only to the studying of the course but also to the acquiring of knowledge and the improvement of the learning process. However, a good sized group of students manifest the need to have previous knowledge of the subject matter in order to fully take advantage of these learning tools. The data of our course has surpassed the average of not only the surgery department itself but of the medicine school and of the UCA in general. We thought that one of the factors influencing these good results that we have obtained has been, precisely, the excellent communication that has been established between students and faculty, not only with the lecturer responsible for the course, but also with other part-time lecturers. These part-time lecturers were more involved and motivated to participate in the teaching of the course, given that their role was no longer reduced exclusively to that of a collaborator in some theory class and to attend to the students in their labs. The only inconvenience shown on behalf of the students has been the difficulty in adapting to the office hours in the virtual classroom.

Regarding the evaluation of the knowledge acquired, we would say that in the traditional method of teaching we only focus on the record of class attendance and the participation in class. Frequently we do not evaluate a student until the day of the exam. In the virtual classroom, a close monitoring of each student can be easily carried out. Although our current evaluation system is based on a traditional test of knowledge, we want to introduce more evaluation tools in the coming courses based on the participation of the student in the virtual classroom.

The use of a common application within the university facilitates and controls both the access of the students and the uniformity of the material. We have used the WebCT and Moodle[6,7] applications in our course. Both software models are designed to unify the technological structure of the teaching material presented to the student. In this way, the student receives said information and participates in the different courses, which follow similar models by which the student avoids learning a new programme with each course. Basically, with them the courses can be organized with a temporary calendar model or an organization with access to the different didactic units. Moodle presents an enormous advantage over WebCT, being a free application, and free to download from the Internet. This software also admits the addition of new collaborative learning tools.

The creation of a course attended on-line requires a great amount of work.[8] However, when completed, it is not complicated to offer it to students of the next generation, or even those from other universities. The didactic material that is "posted" in the application is very laborious to prepare; it requires the lecturer or lecturers to spend a great amount of time to do so, more than that dedicated to prepare conventional courses. However, once the course is constructed, it is very easy and simple to keep the material constantly updated. In this respect, we believe that the rights of the author and the intellectual property should be protected within the general university policies.

The education of the faculty that should direct these courses is a complex and long process. We must insist in the importance of investing in the continued education of the faculty. This entails a great economic and time expenditure for the preparation of the different activities.[9-12] The universities should develop a specific educational programme that offered courses of progressive complexity for the involved lecturers. In addition, we must not miss the opportunity to share sources, models, and images between the different subjects or courses taught. Mechanisms for facilitating the sharing of acquired skills, resources and ideas between the different lecturers should be set.[3] More specifically, the surgery departments should challenge themselves to construct a network of a collaborative exchange of material.[13] Universities should promote the creation of strategic alliances to share, by means of the different departments, on-line teaching units or courses.

Studies have been carried out where computer-based learning is analysed in the teaching of undergraduate surgery. However, these studies are not easily comparable: the learning method used, the learned information, the geographic and cultural differences, the contamination between the control group and the intervention group make it impossible to demonstrate a greater efficacy of this type of teaching compared to the traditional type. Indeed, we give up on trying to carry out a controlled study that would compare our results with those of a group of students that participate in traditional teaching because of the high level of contamination that we would have to fight against.

In the University of São Paulo, a basic 5 week surgery course has been designed. A good level of learning and a high

acceptance rate by the students has been observed in this course.[9] On the other hand, we must say that its elaboration required 12 months of preparation and the participation of 21 professionals. The University of Dublin offers, in a virtual classroom, the teaching of undergraduate surgery during 48 weeks.[10] One of the great advantages observed is the possibility that the students can go to different hospitals to carry out their labs without having to also travel to attend theory classes. The most highly benefited students were seen to be those that got lower grades through traditional teaching. This has also been evident in other non-surgical courses.[12]

Eight learning modules have been developed at the University of Boston based on the resolution of real cases of surgical problems.[14,15] Eighteen-seven percent of the students evaluated this activity as excellent and they claimed that it helped them to improve their results. Furthermore, in a study from the University of Leeds, the students perceived that the knowledge and skills acquired through traditional teaching were greater than those obtained with the electronic learning.[16]

We must point out that, although a well designed study has demonstrated the efficacy of a learning method based on the computer, we cannot guarantee that this method can be transferred to any other area or place. As a result, we must be careful before trying to make this type of teaching general. Although our initial experience has been very positive, at the moment we are designing a controlled study that could demonstrate the benefits of this type of teaching.

We would like to conclude that the teaching of the core course "Basics of Surgery" has been very highly valued within our university. The software offered through the virtual classroom gives us new teaching tools that have been very well accepted by the students that have participated in our courses. The new types of communication established in the virtual classroom between the student and the lecturer allow an efficient flow of information that is very useful for learning, with greater participation and implication of the part-time lecturers.

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