e-MIS Contents: Multimedia Contents for e-Learning Environments in Minimally Invasive Surgery

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ABSTRACT
This work describes the design and application of multimedia contents for web technologies-based training in minimally invasive surgery (MIS). The chosen strategy allows knowing the deficiencies of the current training methods so new multimedia contents can cover them. This study is concluded with the definition of three different types of multimedia contents accordingly to the development degree and didactic objectives that they present: Didactic resources are basic contents such as videos or documents that can be enhanced with contributions of users. On the other hand, case reports and didactic units have a defined structure. Didactic resources and case reports provide an informal training while didactic units are included in a more regulated training.

General Terms
Minimally Invasive Surgery, Multimedia Contents, Web Technologies

Keywords
Minimally Invasive Surgery, Multimedia Contents, Web Technologies, Teaching innovation, Surgical Videos

1. INTRODUCTION
Minimally invasive surgery (MIS) is a compendium of surgical techniques for diagnose and/or treatment by means of introducing the laparoscopic optic and surgical tools in the abdominal cavity through small incisions [1]. In the last years, MIS has been introduced in the surgical practice and has become a gold standard in many surgical procedures over open surgery. This is mainly due to the multiple benefits for the patient: lower tissue trauma; lower morbility; and shorter hospital stay and recovery time. All these advantages for the patients are also advantages for the health systems since the use of resources are optimized [2-4].

Therefore, the introduction of MIS in the daily clinical practice has resulted in the need of training surgeons in a surgical environment different to the traditional one of open surgery. The halstedian method consisting on "see one, do one, teach one" must be accompanied by the acquisition of new skills which are characteristic of the MIS techniques [5-6].

Training in MIS can be divided in two main parts [7]: cognitive and psychomotor training. Cognitive training includes the acquisition of theoretical knowledge related to the surgical procedure: steps which compose it; involved anatomical structures; surgical instrumental to be used; complications that may arise during the intervention… On the other hand, psychomotor training [8] comprises the acquisition of surgical skills required to accomplish a minimally invasive surgical procedure without compromising patient security. Currently, cognitive training is mainly based on reference books and multimedia guides in CD-ROM or DVD and expert surgeons. Furthermore, it is also usual to assist to in-person activities such as specialized courses, lectures or congresses in centers devoted to MIS training [9]. These courses are mainly focused on psychomotor training but they have a great theoretical load at the same time. Short courses are currently the most common training method for professional continuing education in MIS, despite the surgeon's overloaded schedules. This is one of the main inconveniences for continuing MIS training. [10].

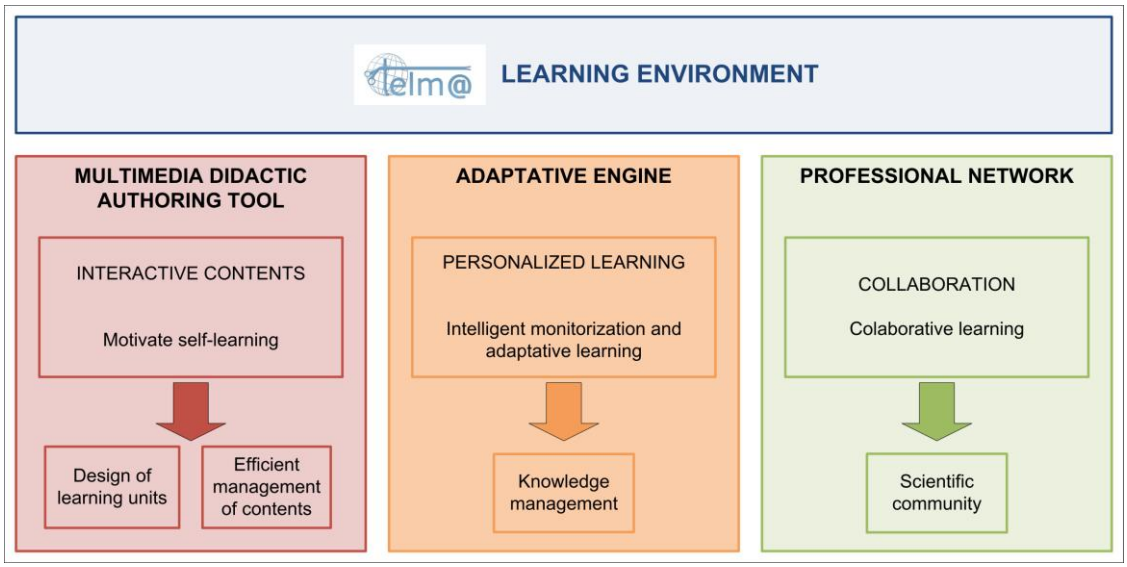

Fig 1: TELMA blocks structure.

The use of web technologies and multimedia contents is also being introduced in MIS training. Thanks to the indirect visualization of the surgical field through a screen, this kind of surgery generates a wide amount of didactic material in the form of video, which seldom is reutilized for didactic purposes. The exploitation of these resources for the creation of online learning environments (e-Learning) can contribute both for the efficient reutilization of the contents and the optimization of the training process of new surgeons.

Incorporation of e-Learning platforms in the field of MIS training is in an early stage. There are currently available some websites which are mainly a repository of surgical videos, such as WebSurg [11] or webOp [12]. Besides these, some new initiatives are being carried out in order to include an informal training approach to those contents, such as Medting [13] or Surgytec [14]. Nevertheless, some needs which are not covered by these environments have been detected; for example the possibility of an adaptive learning process to the specific user needs or didactic contents aimed at particular characteristics of MIS training.

2. TELMA LEARNING ENVIRONMENT

TELMA [15, 16] is a learning environment based on web technologies which will enhance the learning process (both initial and life-long learning) in MIS by shortening the learning curve, giving a ubiquitous access to multimedia didactic contents, adding interactivity during the learning process and providing an active role to surgeons in training within a collaborative environment. Figure 1 shows a block schema with the three main modules of TELMA learning environment: an authoring tool that allows creating and editing didactic contents, an adaptive engine that provides a personalized learning and a thematic professional network that provides the system with communication channels that make easier the informal learning among TELMA users.

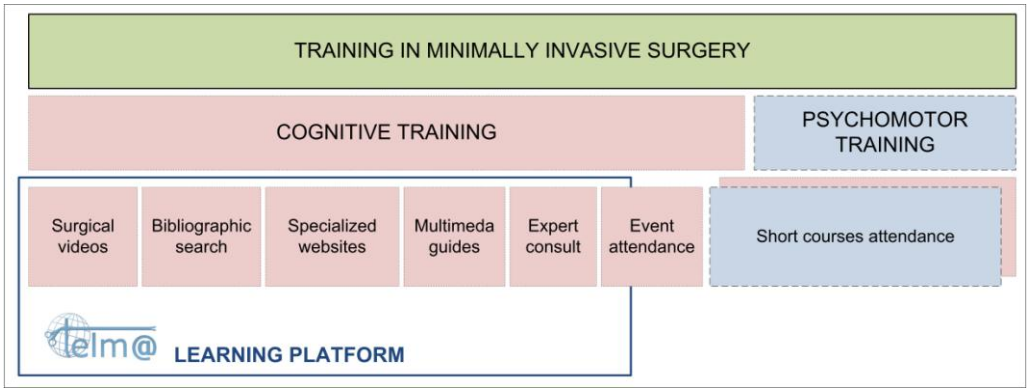

Fig 2: Current methods for MIS training and inclusion of those in the TELMA learning platform. In-person activities such as event attendance are not included in the platform but information about them will be properly spread among TELMA users. Psychomotor training is out of the scope of this work.

TELMA platform includes most of the traditional methods of cognitive training in MIS, as can be shown in Figure 2. This way, advantages of e-Learning are also incorporated to the learning process: ubiquitous and at–any-time access, easiness to upload and update contents, personalized instructions or distribution easiness [17]. Furthermore, the three modules comprising TELMA add didactic value to traditional e-learning approaches.

A learning environment as the proposed one requires contents specifically focused towards MIS formation, keeping user interest while providing the information that is really useful for training.

The objective of this work is to define the type of contents that better adapt to the specific needs of surgeons who want to acquire cognitive training in MIS, considering the peculiarities of these surgical techniques and giving preference to visual contents and exploiting all information provided by multimedia contents.

3. METHODOLOGY

In order to define which contents are useful for a MIS learning platform, several interviews to experts with a wide background in MIS and experience in the teaching field were conducted [18]. These interviews allowed determining the current learning methodologies and the perception of surgeons about e-Learning platforms and multimedia contents applied to MIS training. Based on the results, we concluded that there is a real demand by users for the implementation of web environments based on multimedia didactic contents to train new surgeons. Taking the conclusions as baseline, a survey was designed to confirm the previous results by a larger and more heterogeneous group of final users. Survey results were similar to the opinion of experts [19].

When proposing possible designs of multimedia contents which would result in a learning platform of quality, characteristics exposed by Cabrero *et al.* [20] were taken into account. Those characteristics are shown in Table 1. The final aim was to define multimedia contents that provide flexibility to the environment, that can implicate and motivate the learner while capturing his/her attention.

Table 1. General characteristics of a quality learning environment [20]

Characteristics of a good learning website	Characteristics of a bad learning website
Interactive	Passive
Non linear	Linear
Clear and easy interface use	Confusing, graphics occupy the interface
Structure lectures	Unstructured lectures
Multimedia	Intensive texts
Attention to educational details	Lack of attention to educational details
Attention to technical details	Lack of attention to technical details
The user controls the system	The system controls the user

With all the gathered information, different models of contents were proposed and validated with surgeons of the Laparoscopy Unit of the Jesús Usón Minimally Invasive Surgery Centre (Cáceres, Spain). This institution has more than 25 years of experience in the field of MIS training and organizes more than 100 training activities per years with more than 1350 surgeons. At this point, an iterative strategy was used, with periodical meetings with a panel of expert surgeons. Designs were refined until obtaining contents that satisfy the current training needs in

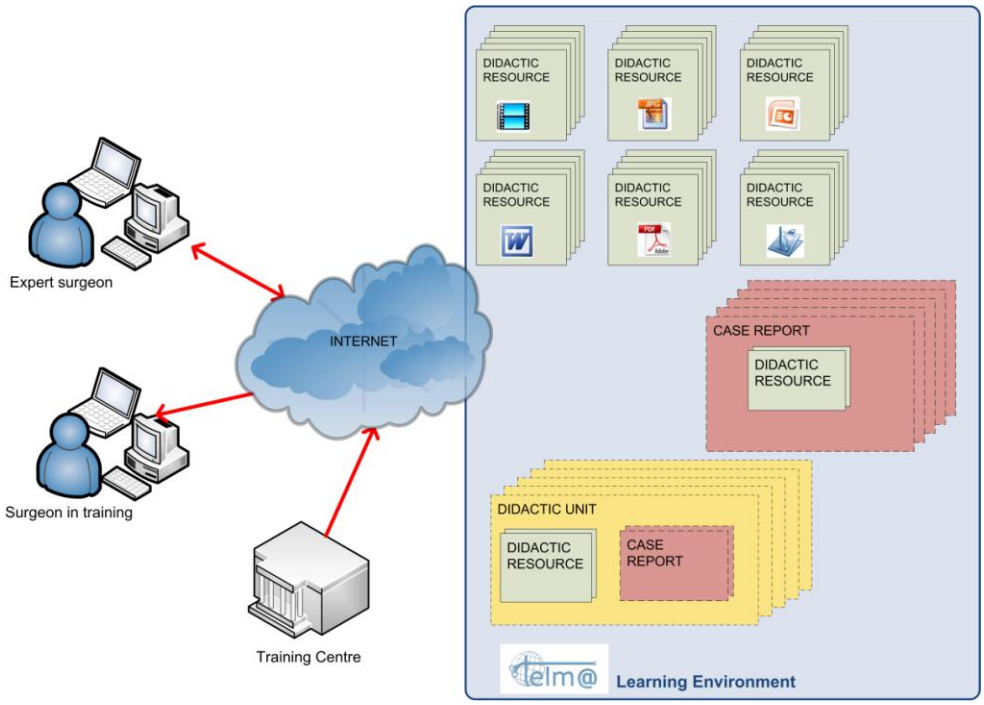

Fig 3: TELMA learning environment and implicated agents.

MIS from the point of view of expert surgeons.

4. MULTIMEDIA CONTENTS FOR TELMA ENVIRONMENT

Multimedia contents included in the TELMA learning environment are classified in three categories attending to the degree of elaboration and didactic objectives they have into: didactic resources, case reports and didactic units.

The definition of multimedia contents of different nature pursues the implication of the different agents participating in the TELMA learning environment: surgeons in training, expert surgeons and training centers. The former will consume contents from the environment meanwhile the latter will provide them. On the other hand, expert surgeons can be both consumers and producers of contents (Figure 3).

By *didactic resource* we mean any content that is shared in the platform and provides didactic information; that has a significant weight and is not composed by different elements. The types of didactic resources considered are surgical videos, text documents, images and evaluation exercises. Active participation will be encouraged, allowing different actions on the didactic resources in order to improve user interaction in the platform: make comments; add tags to identify the content; upload related contents; include time stamps of points of interest and video edition (segmentation and tracking of anatomical structures, image enhancement and other basic video edition tasks). This way, didactic resources will be enhanced with the contributions of the different roles present in TELMA learning environment. Furthermore, interactive evaluation exercises related to a resource can be created so surgeons in training can acquire knowledge in an interactive and non linear way.

These multimedia didactic resources compose the content base unit in TELMA environment and the rest of didactic elements present in the platform will be created from them. This way, structured and non structured contents will be available.

Within structured contents, a division can be done regarding the didactic objectives. For informal learning, case reports are defined. On the other hand, didactic units are included within a regulated training, as opposed to the previously described contents which are included in a non-regulated training

A *case report* supports its own structure (Table 2) and contains a specific casuistry related to a surgical procedure. It always comprises a surgical video that can be accompanied of extra information and evaluation exercises to enhance it.

Didactic units are the most complex type of content and they present a more defined and structured pedagogical and educational approach.. A didactic unit focuses on a specific topic and will cover a wide spectrum of related information that allows an understanding of the presented issue. The creation of this type of contents is limited to training centers and users with a recognizable experience in MIS training. As case reports, didactic units have a defined structure which is shown in Table 2. Evaluation section includes exercises that allow users to examine themselves on the acquired concepts after they carry out the didactic unit.

Table 2. Characteristics of multimedia contents in TELMA learning environment

Multimedia content	Included material	Content structure
Didactic resource	One of the following elements: Surgical Video Image Document Exercise	Does not have a specific structure
Case report	One surgical video Other resources (optional)	Case history Preoperative period Intervention Postoperative period
Didactic unit	One case report Other resources (optional) Other case reports (optional)	Anatomy Physiology Pathology Evaluation

5. CONCLUSIONS AND FUTURE WORK

E-learning provides learning material and 24/7 support from everywhere: working place, teaching site or home. Contents provided on an e-learning platform must add value to existing resources rather than simply duplicating them and should accommodate various learning styles and behaviors [21]. Therefore, it is important to define contents accordingly to the specific needs of MIS training.

The definitions of multimedia contents presented in this work have been obtained after a process of research and development where there has been a direct contact with the final users of the platform. The proposed methodology allows adjusting the design of contents to the actual needs in the field of training in minimally invasive surgery, and therefore, lead TELMA e-Learning platform to be a regular and efficient educational tool within the current training process. This way, advantages of e-Learning would be included in a training process that currently lacks them and where users have a great limitation on the time available for training. The three types of contents: didactic resources, case reports and didactic units, have been included in the implementation of TELMA learning environment and will be validated during the last phase of the project, planned for the last semester of 2011.

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