

# ICT support for the retention and consolidation of knowledge in the classroom

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## Introduction

The visible changes in European universities that have followed the directives of the European Higher Education Area (EHEA)<sup>1</sup> are evidence of a deep transformation that has led to the adoption of educational practices focused on monitoring the learning process (Benito & Cruz, 2005; Ashwin, 2006: 3-15). The fundamental transformation of university education depends not so much on the current reorganisation of studies but on the complete redesign of the teaching process and its oversight and evaluation. The changes that are now in place in the organisation of studies are the result of the evolution of pedagogical models and methods (López Alonso, 2009). These new approaches have emerged as a result of the introduction of new educational approaches and the consolidation of technology used for teaching.

Although one may have the impression that this shift has been abrupt (and to some extent it has), there have actually been continuous methodological evaluations and updates related to the use of technology over the past decade. Because this is a topic of interest across all fields, the results of congresses, conferences, scientific meetings, and a prolific body of emerging literature have led to the development of new ways of communicating and transmitting knowledge. The summation of these efforts (in many cases at the level

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<sup>1</sup> Declaration of Bologna, 1999. For a more detailed analysis of European directives in the last decade, see López Alonso, 2009 and Matesanz del Barrio, 2010.

of individuals, but with increasing institutional participation) has opened up unexplored routes through which teachers and students within our universities have connected.

## **Pedagogical Renewal and Survival of the Lecture**

The EHEA has provided a fairly standardised framework for the development of university education, although the organisation of teaching and the establishment of the teaching load has a preset minimum margin. One of the constants across all of the plans is the recognition of the face-to-face class as a vehicle for transmitting knowledge. The Spanish legislation upon which the existing curriculum is based<sup>2</sup> specifically mentions the importance of both theoretical and practical training of students, which means that at least some lessons are tightly linked to the face-to-face class. The maintenance of the allocation of class hours at a level similar to the current system is an explicit sign of the recognition of the importance of face-to-face classes, as this is one of the few features that has been retained from an otherwise declining traditional system of education in Europe. Although the terms face-to-face class (*clase presencial*) and lecture (*clase magistral*) are often used interchangeably, these two terms do not have the same meaning. Face-to-face class is more comprehensive, and lecture indicates a type of face-to-face instruction. Strictly speaking, and in accordance with academic tradition, lecturing can be defined as the theoretical transmission of scientific knowledge from teacher to student in an academic session in the classroom<sup>3</sup>. The evolution and renewal of teaching has also handed over to theoretical governing other activities that involve interaction with students, giving rise to what we understand today as being part of a face-to-face class. However, the

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<sup>2</sup> The Royal Decree 1393/2007, of 29 October, regulates official university teaching in Spain with explicit reference to the theoretical and practical training of students.

<sup>3</sup> A recent definition and concise analysis of the English term *academic lecture* is found in Lee (2009: 42), who, following other authors (Flowerdew, 1994, Flowerdew and Miller, 1997, Thompson, 1994 and Young, 1990, 1994), considers it to be the main kind of instruction and an essential means of communicating to the student the basic knowledge of a discipline.

distinction between lecture and face-to-face class is, in many cases, difficult to make because they sometimes overlap or even coincide, mainly, though not exclusively, in courses with a large number of students.

The characterisation of traditional teaching presented in a report of the World Bank (2003: xix)<sup>4</sup> shows some of the negative features of this system, which is based on the teacher as the starting point for direct instruction: (i) the teacher is the source of knowledge; (ii) the learners receive the teachers' knowledge; (iii) the learners work on their own; (iv) tests or examinations are applied to assess progress leading to students fully mastering a set of skills and having rationalised access to future learning; and (v) the learners all have access to the same information. The lecture plays a key role in this kind of teaching.

Although there is much criticism of the lecture paradigm, not all commentary is negative, and, even in its most traditional form, the lecture has played a crucial role in university learning for some time (Evans, 1998; Biggs, 1999; Knight, 2002; Zabalza, 2003). The analysis carried out by Biggs (1999: 129) focused on two main elements of value in the lecture paradigm: (i) the communication of information and (ii) the presentation of the teacher's original work<sup>5</sup>. The absorption of both these elements is mediated by the student's ability to concentrate. Briggs even posits that the main contribution of the lecture is the link the teacher establishes between research and teaching. Certainly, the confluence of research and teaching in the figure of the teacher ensures that he or she is abreast of the latest research on the subjects being taught, and such is the hallmark of this system. The original and new contributions of the teachers are the result of their

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<sup>4</sup> However, it should be kept in mind that this study, widely cited in works on education, particularly those related to learning throughout life, focuses on education in developing countries and economies in transition, so that the characterization of traditional teaching that is offered cannot be extrapolated in some specific points to the situation in developed countries.

<sup>5</sup> Further, in a later passage (1999: 151), Biggs notes that almost the only advantage of this method over others "is that it gives students the teacher's living thought."

parallel investigations, which give a specific value to the class. The information on a subject, by itself, does not involve the interpretation and assessment of data, and might thus be communicable to students through other means, many of which are linked to technology.

The growing use of virtual university campuses, used both outside and inside the classroom, and the ability to download podcasts of classes are examples of ways of transmitting information without the direct involvement of the teacher. In addition, although a teacher's interpretations and contributions can be accessed through virtual classrooms, contextual information, which is traditionally communicated via face-to-face interaction with students, is not easily substituted or virtually reproducible successfully over a long period of time, at least so far. The use of the classroom gives the student the opportunity to intervene practically at any time. Students may seek clarification when questions arise or offer, for example, different views on a topic. These are situations that are not possible to recreate in an exact way when the student is not a direct actor in the learning process, but rather a passive agent. The uniqueness of the face-to-face class lies, therefore, in the exchange between teacher and student, both on individual and group levels, as debates, questions, and teacher questioning that progress over the course of the class do not arise and develop in the same way outside the context of classroom teaching.

However, the first point highlighted by Biggs, the communication of information, is gaining more prominence in the face-to-face class than he gave it, as technology in the classroom is now also used for the transmission of information, giving rise to different type of communication. The so-called digital maturity, effective in non-university education in recent years (Butt & Cebulla, 2006, Balanskat, Blamire, & Kefala, 2006; Durando, Blamire, Balanskat and Joyce, 2007; Underwood, 2009), can also be considered as present in universities and other areas (CEC 2008). At present, teachers make use of the available technological teaching resources according to their own technological training and the opportunities offered by the institution for which they work. The literature on the use of software tools, platforms and virtual campuses to promote the learning process is very broad and

has been generated simultaneously in all areas of knowledge.<sup>6</sup> This interest in new educational [approaches](#) and technologies that are easy to implement has contributed to the creation of a shared common knowledge, which is essential to progress in the simultaneous renewal that is taking place in higher education.

### **Microsequences of the consolidation of learning**

One of the problems of learning that still not fully solved is how to retain knowledge gained in the classroom (Ausubel: 2000). The search for a methodology that brings success in this difficulty in the classroom has led to the development of different classroom activities, many of which are currently supported by ICT. The proposed consolidation of theoretical knowledge contained in the lecture has so far been limited to the development of classroom activities interspersed throughout the class or activities at the end of class that ask the students questions about its content, which requires students to actively review what had been taught (Bligh 1971). It has also been proposed to perform an exam just after the lecture<sup>7</sup> (Nilson 1998: 77). Of the consolidation proposals that have been submitted, the activities undertaken at the end of the class have, from our point of view, a particular interest not only for students but also for teachers. It is at this point that we have developed, implemented and experimented with our students the microsequences of the consolidation of learning.<sup>8</sup> We

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<sup>6</sup> In relation to teachers' use of commercial software tools, we refer, by way of example, to two studies on the effectiveness of using popular commercial tools such as PowerPoint™ (Savoy, Proctor and Salvendy, 2008) or Excel™ (Almenar Llonga Hernández Sancho, 2009). A recent review of learning platforms can be found in Fernández Pampillón, 2009, and an analysis of the Virtual campus can be found in Stansfield et al., 2009.

<sup>7</sup> Quote by Knight (2002: 148).

<sup>8</sup> As the courses were not big, the experiments were held during four consecutive semesters in two subjects: *Semantics* and *Foreign Language*

define these microsequences of consolidation as *short pedagogical sequences focused on the review and identification of the most relevant content of an academic session to facilitate the retention of these items and facilitate progression in the learning process.*

The microsequences of consolidation we propose correspond to the achievement of the two elements of the lecture that Biggs (1999: 179) considers key to proper understanding by the students: (i) understanding the message and (ii) developing a fundamental grasp thereof. Because, as Biggs points out, most lectures cannot do these two tasks simultaneously, the sections of presentation and consolidation must be separated.

The contributions of the methodology we propose are all consistent with the objective of the consolidation and retention of information, but they occur at three discrete points: (i) during the session, because it allows students to quickly review the content they have just seen, identify problems in understanding any issues raised in class and summarise the information received with key words and questions; (ii) in the subsequent face-to-face session, which allows feedback and leads to a quick review of the topics already seen using the previous day's work as a starting point; and (iii) at the end of the study unit, because the students have, at that point, obtained a sequential flow of material containing both theoretical and practical content and also have learning materials created by all group members available for reference.

Of the methods developed so far to acquire and retain knowledge, we have selected and adapted the two that seem most appropriate to our aims: (i) key questions and (ii) concept maps. There is a great difference between these two items, mainly in their degree of methodological development and educational purpose. The use of key questions is a general method used to specify and summarise the basic points of the topic or problem analysed. Although these questions are frequently used for the demarcation and analysis of issues, a specific teaching methodology has not been developed to implement this

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*Acquisition* within the Linguistics Major at the Complutense University of Madrid.

activity, as has occurred with methods such as case studies. In contrast, concept maps, which were initially a conceptual visualisation method, have led to a methodology (Novak, 1998; Cañas, Novak & González (eds.), 2004; Novak & Cañas, 2008) that has transcended the field of education from which it originated and that currently works with software tools developed for its implementation (Cañas et al., 2004b)<sup>9</sup>.

There is another difference in use between the two methods that should be noted: while key questions involve activities taking place entirely in the classroom, concept maps can be done in the classroom if the necessary tools are available, or in a mixed form, both inside and outside the classroom.

### **Methodology and development of the microsequences of consolidation**

The microsequences, being designed to promote consolidation and retention of the information obtained in a face-to-face class, are implemented during the last ten minutes of each session. The activity begins with the individual reading of the notes taken during class so that the student (i) reviews the contents and identifies points that are unclear, and (ii) summarises the information that has been learned, extracting keywords and asking questions about the content.

The student also works with the classroom content outside the classroom, enabling a more effective consolidation of knowledge by returning to the information at different times, thereby enhancing retention. The work done outside the classroom, in particular flexible learning, is conceived as a way of learning that can be complementary or alternative to the face-to-face class, but has not previously been considered as a way of consolidating knowledge obtained in class.

Our proposal is presented within the teaching program as a scoring practice conducted by the students during the semester, which involves several opportunities for practice, as many as topics or content units are proposed in the course syllabus. The type of practice, key questions or

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<sup>9</sup> *CmapTools* software <http://cmap.ihmc.us>. This is not the only tool available, as there are other types software, both free and paid, that can create concept maps.

concept maps is chosen to fit the content of the topics. Although the time spent on each unit of content is similar, the number of sessions and the date of information delivery are fixed beforehand so that students know the schedule in advance.

The development of these activities, sequenced in eight steps (Appendix 1), has a common framework (points 1, 2, 3, 4, 5, 7 and 8) and a specific structure (points 6.a and 6.b). The last 10 minutes of each 90-minute face-to-face class are always reserved for the systematic reading of the notes taken during the session (whether theoretical exposure, exercises, discussions or any other activity that has taken place during class). If questions arise, they can be asked at this time, or, if they require more time than is available, they can be resolved at the beginning of the next meeting.

The specific implementation begins at this time. If the activity chosen is the key question (6.a), each student must ask three questions related to the subject matter at the end of each session. When a topic is completed in the session, the students will go over their key questions and select the five questions they consider the most applicable to understanding the content of the subject. This practice is intended to be performed individually in the classroom, and the students will use the virtual classroom to present their work, that is, the key questions, the questions for each of the sessions and the questions selected for the subject. Once corrected, the teacher will make the most significant key questions from each topic covered in class available to all students so that through the virtual campus, students will have learning materials available and will be able to verify the knowledge they have amassed about the content viewed. The development of concept maps (6b) occurs at multiple times, both at the end of the class sessions, as mentioned above, and outside the classroom. The activity we suggest is the use of concept maps for information already known (Matesanz, 2009: 158). The implementation for this method is the same as for the extraction of keywords, but work should then continue either inside the classroom (in which case the temporal planning varies considerably, and there should be at least twenty minutes more for the activity) or outside the classroom. Starting with information obtained from the key words and questions for all the sessions, and, if necessary, using additional literature, concept maps are developed with the help of



software tools. The concept maps are also presented through the virtual campus, with a tab control of time spent to allow for assessment of student difficulties in elaborating the maps. After correction, the maps are made available in the virtual campus course for free consultation.

### **Implementation of Microsequences in LAMS**

We have not yet made reference to the actual implementation of our microsequences, for which there are several possibilities. We believe the most suitable platform for implementing the microsequences of consolidation is LAMS (Learning Activity Management Systems)<sup>10</sup>, a system that originates from learning activities designed by MELCOE, the center of excellence for e-learning at Macquarie University, Sydney. This software platform focuses on the design, transmission and use of learning sequences. For LAMS' designers, the key learning occurs in the interaction between students and teachers, not just the interaction with the content. Although LAMS is oriented toward group learning, it allows individual work under the same conditions. We will highlight two of the several advantages of this platform for the teacher: (i) the ability to control the learning process throughout all the stages and (ii) the possibility of reusing the design for other activities of their own or even those of other teachers. This last feature is enhanced by the fact that LAMS can be used as an independent platform or integrated as a tool in other environments. For example, LAMS is fully integrated in Moodle, Blackboard and Sakai.

LAMS, in its latest version, 2.3, has four different interfaces: (i) the design interface, (ii) the monitoring interface, (iii) the student interface, and (iv) the pedagogical plan interface.

The flexibility of LAMS assists students in the completion and delivery of these activities, as one of the most common problems encountered by students is the incompatibility of tools that do not belong to the virtual platforms with the requirements of the platforms themselves. For the teacher, LAMS offers the great advantage of effectively monitoring at all times the activities of each student and the ability to intervene whenever needed. In addition, the ability to modify

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<sup>10</sup> <http://www.lamsinternational.com/>

the design is open and ongoing, and it is possible to reuse previously designed sequences, whether or not they are designed by the same teachers; and that, by itself, saves time.

## Conclusions

Judging by results, the methodology we have presented and used with our students has been beneficial, though these results are still incomplete (Matesanz, 2009: 167). We can globally summarise the contributions of the microsequences from the perspective of students and teachers separately, as both can benefit from their use.

The student consolidates new knowledge through sequenced activities via (i) a review of the information accumulated in an academic session; (ii) identification of elements that are not sufficiently clear; (iii) identification of relevant information; (iv) a brief and ordered reformulation of information; and (v) free access to all the material from the class, both their own and the group's, once corrected.

The microsequences open new routes to teacher involvement in the learning process by offering the possibility to (i) track the learning process derived from the face-to-face classes; (ii) restructure the subject upon detection of difficulties in understanding; and (iii) quickly review the contents of the preceding class at the beginning of a new session to contextualise the new information.

The microsequences of the consolidation of learning not only include these activities, they also offer other possibilities during the face-to-face class. We are presently working on these other possibilities.

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## APPENDIX 1

### **Order of the microsequences of the consolidation of learning.**

(1). Selection of the methodology (key questions or concept maps) according to the content to be addressed.

(2). Agreement on the number of sessions and due dates for assignments.

(3). Use of the last ten minutes of the session for the activity.

(4). Reading of the notes taken during the class.

(5). Selection of five keywords.

(6.a) Keywords

- Formulation of three questions about the scheduled session.
- Upon completion of the last class of the unit, re-reading all the key questions and selecting the five that are most relevant.

(6.b) Concept Maps

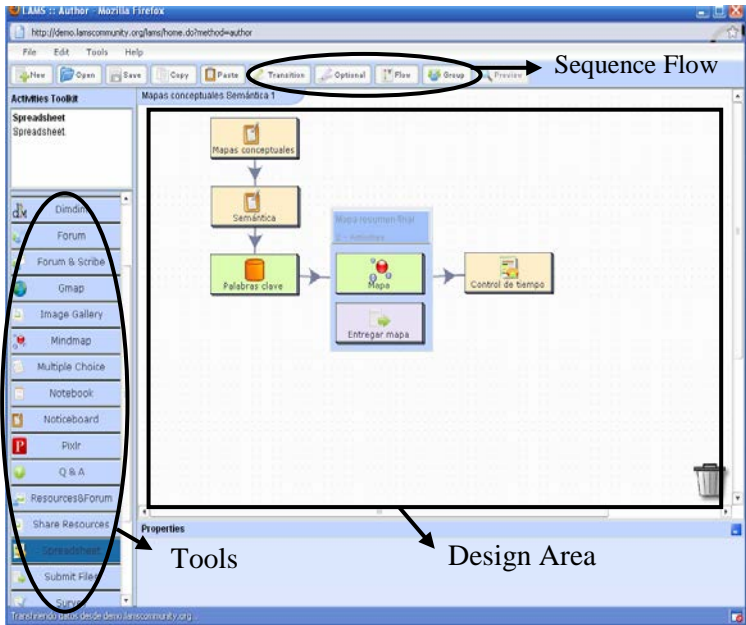
- Information review in the classroom using key words and questions.
- Literature exploration, if necessary.
- Design of a concept map using a software tool.
- Recording the time spent on the activity on the timing sheet.

(7) Submission to the virtual campus.

(8) Once revised by the teacher, free access is granted to all work posted by the group.

## Appendix 2

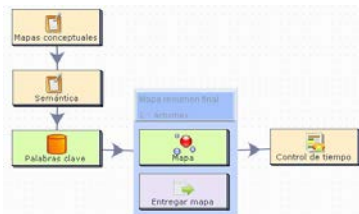
**Fig. 1 LAMS authoring interface:** the most important areas within it are highlighted, design area, tools and sequence flow.



**Fig. 2 Key question microsequence:** different activities that constitute the sequence



**Fig. 3 Mindmap microsequence:** different activities that constitute the sequence





**Fig. 4 LAMS student interface:** the most important areas within it are highlighted, working area and sequence line.

