

# Learning Management System (LMS) for Integrating, Monitoring and Evaluating Professional Activities in a Medical Curriculum. The Experience at Humanitas University Medical School

Vinci V.<sup>1\*</sup>, Lozito A.<sup>2</sup>, Montagna L.<sup>3</sup>, Oldani S.<sup>1</sup>, Marsala A.<sup>4</sup>, Pagliotta M.<sup>4</sup>, Consorti F.<sup>5</sup>.

<sup>1</sup>Office of Medical Education, Humanitas University, via Rita Levi Montalcini 4, 20090 Pieve Emanuele (MILAN) – Italy.  
Humanitas Clinical and Research Center – IRCCS-, via Manzoni 56, 20089 Rozzano (MILAN) – Italy.

<sup>2</sup>via Rita Levi Montalcini 4, Humanitas University, 20090 Pieve Emanuele (MILAN) – Italy.

<sup>3</sup>Office of Medical Education, Humanitas University, via Rita Levi Montalcini 4, 20090 Pieve Emanuele (MILAN) – Italy.

<sup>4</sup>IT Department, Humanitas University, via Rita Levi Montalcini 4, 20090 Pieve Emanuele (MI-LAN) – Italy.

<sup>5</sup>Department of Surgical Sciences, Sapienza University of Rome, Viale del Policlinico, 00161 Roma – Italy.

Received: 1 Oct. 2020, Revised: 21 Nov. 2020; Accepted: 19 Dec. 2020.

Published online: 1 Jul. 2021.

**Abstract: Background:** Technology-enabled learning is increasingly important in teaching and learning medicine. At Humanitas University we started using LMS (LMS@Hunimed) also for the organization, management, storage and evaluation of medical education and professionalizing activities.

We explored the perceived benefits and practical use of a LMS by The Office of Medical Education in organizing, managing and evaluating professionalizing activities.

**Summary of the work:** An evaluation questionnaire on LMS was submitted to all members of the OME (7 members) and the Student Office (2 members). Furthermore, Humanitas University register's office provided a quantitative evaluation of the working hours by the members of OME regarding organization, management and assessments of E- Portfolio on LMS compared with Portfolio before LMS.

This study involves the testing of all four operational criteria on learning management system:

- Effectiveness – The performance in accomplishment of tasks
- Learning ability – The degree of learning to accomplish tasks.
- Flexibility – The adaptation to variation in tasks and environments.
- Attitude – The user satisfaction or suggestions for improvements.

We choose to use a System Usability Scale (SUS), a simple, ten-item attitude scale, to provide an assessments of usability.

**Summary of results:** The use of LMS showed improvements in work efficiency through a significant decrease in working hours. Furthermore, a qualitative analysis of the System Usability Scale (SUS) questions showed that teachers felt more confident to use LMS in their daily tasks compared to when using a non-digital approach.

**Conclusions:** LMS@Hunimed showed positive results in providing functional direct access to messaging tools for communication and concrete didactic support for students, teachers and collaborators.

**Keywords:** Learning management system; moodle; medical education; professionalizing activities; distance education.

## 1 Introduction

Technology-enabled learning is increasingly important, pervasive in education and change the approach in teaching and learning medicine. The Learning Management Systems (LMS), a web-based e-learning supporting platform, allows instructors and students to share instructional materials, make class announcements, submit and return course assignments, and communicate with each other online. Over 90% of American Universities<sup>1</sup> have established one or more LMS products for students and faculty use. Despite increasing adoption of these systems, very little is known about their benefit in learning<sup>2</sup> or their practical purpose in education<sup>3</sup>. LMS is both cause and result of significant changes in the definition of the concepts

\* Corresponding author E-mail: valeriano.vinci@hunimed.eu

of education and in the understanding of how this should be organized and managed. In addition, users report that LMS is a great resource for time management as well as for improving learning<sup>4</sup>.

The use of LMS allows students to independently gain access to notes and academic sources, discover further information on their own and therefore experience a personalized education<sup>5-6</sup>. Although most LMS are used for the distribution, management, and retrieval of course materials, these systems can also incorporate functionalities that support interactions between students and instructors and among students<sup>7</sup>. Such features provide opportunities for enabling institutional innovations in learning and education<sup>8</sup>. For such reasons, it is important for LMS to live symbiotically with the standard face-to-face teaching of the curriculum, as the risks of creating two detached worlds would be penalizing instead of supporting such a compact and complex learning path as the medical one<sup>6</sup>.

An LMS platform can implement a whole series of tools and materials for the student's self-directed study and development, as well as individual tools for self-assessment and learning progress verifications<sup>9</sup>.

From an academic point of view, this revolution has created the need to develop increasingly flexible information technology (IT) systems capable of adapting to the teaching needs of each subject at the University. The development of technologies in the field of training and learning of clinical skills has offered more and more tools through which to acquire and develop advanced clinical reasoning skills and competences, for example High Fidelity Simulation, Virtual Games, etc<sup>5</sup>.

One of the most used systems in the world is the Modular Object-Oriented Dynamic Learning Environment (Moodle), created by Martin Dougiamas (Curtin University of Technology, Perth, WA, Australia)<sup>5</sup>. Moodle is a flexible system that allows IT to develop virtual spaces that can support students-students and students-teachers communication during the training process.

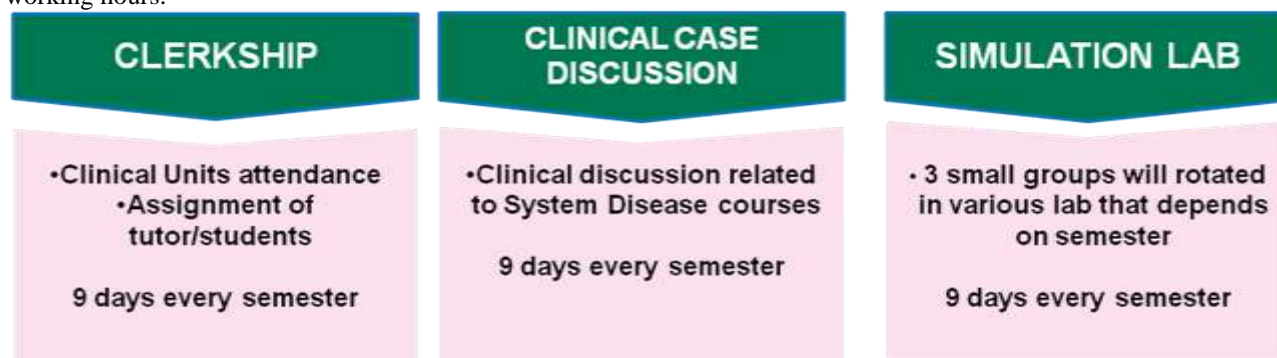
At Humanitas University we started using LMS also for the organization, management, storage and evaluation of the professionalizing activities which medical students carry out in the hospital and in simulation rooms.

This choice required to exploit the Moodle architecture by implementing it with specific tools that allowed tutors and students to virtually dialogue in a simple and flexible way. Many critical issues were addressed, including group and subgroup management, evaluation score calculation and its conversion into final grades, management of attendances and planning of rescheduled teaching sessions for justified students who missed mandatory activities.

Before the establishment of an e-portfolio on LMS, the didactic material of the professionalizing activities produced by each student on paper was manually archived and corrected by the Office for Medical Education (OME). This method required longer time for the assessment of each activity and carried higher risks of material loss and human error in grading.

In this study, we explored the perceived benefits and practical use of a LMS by OME in organizing, managing and evaluating professionalizing activities (Portfolio activities) [FIG.1].

The purpose of the article is to verify the usability of LMS and if the use of LMS increases efficiency in terms of dedicated working hours.



**Fig.1:** Organization of the professional activities (Portfolio activities) at Humanitas University.

## 2 Materials and Methods

### Humanitas Research Hospital and Humanitas University

Humanitas Research Hospital is a highly specialized teaching and research hospital. Accredited by the National Health Service, Humanitas houses world-level doctors across more than 50 clinical domains grouped in specialized centers: Cancer, Neuro, Cardio, Orthopedic, Fertility, Obesity, Ophthalmology, Internal Medicine and Check-up, Pancreas and Duodenum conditions, Chronic Inflammatory Bowel diseases, and Immunology. The Hospital is also equipped with the Emergency room and the outpatient Radiotherapy Area.

The Italian Ministry of Health granted Humanitas the status of a Research Hospital (IRCCS) with the focus on diseases of the immune system, ranging from cancer to rheumatoid arthritis.

The research and teaching functions are also critical for Humanitas. The Medical school, established in the year 2000, and later transformed in Humanitas University “Hunimed” houses over 1000 medical, nursing, and physiotherapy students from all over the globe. Humanitas Research Center, employing researchers from 15 different nations, conducts both pre-clinical studies and randomized controlled trials, and is considered to be in the top 6% in the world based on its publications’ impact factor.

## The Office for Medical Education

The Office for Medical Education (OME) is the institutional body that relates directly to the Presidency and coordinates the objectives of the professionalizing activities in constant relationship with the faculty's teachers, also acting as a mediator between the university and the hospital. Humanitas University is in fact a Teaching Hospital formed by a Faculty and an open Faculty, i.e. doctors selected and trained to carry out teaching activities (lessons and professionalizing activities). It is made up of 6 doctors (1 internist, 4 surgeons, 1 orthopedist), a pedagogist, a computer engineer, an IT specialist and an administrative secretary.

## Learning Model

Is it possible to approach the search for an integrated model for online education from the face-to-face education in general or even the blended learning perspective? Bosch<sup>10</sup>, in a review of instructional technology, identified and compared four blended learning models using twenty-one different design components. These models emphasized, to one degree or another, the integration of pedagogy and technology in course design.

At Humanitas University we have chosen a Blending with Pedagogical Purpose Model developed by the OME, in which pedagogical objectives and activities drive the approaches, including the online technology that faculty members use in instruction.

During the third, fourth and fifth year of training students are respectively:

- **Reporter** – collect and communicate the patient's problem clearly and precisely (3rd year)
- **Interpreter** - analyzing and prioritizing the patient's problem (4th year)
- **Manager** - manage the main patient problem (5th year)

## Portfolio

Several models of portfolios have been described. The appropriateness of each model depends very much on its purpose and whether it will be used in an assessment process.

Portfolios were initially used in medical education for formative purposes in order to encourage reflection<sup>11</sup>. More recently, the use of portfolios has been advocated for summative purposes<sup>12-13</sup>.

Actually at Humanitas University we use a spinal column type of portfolio and individual pieces of evidence are linked to predefined competencies (each competency has its own evidence) [FIG 1].

## Learning Management Systems Features

Humanitas Learning Management Systems (LMS@Hunimed) is based on Moodle Web Platform (Modular Object-Oriented Dynamic Learning Environment), an open source technology developed in PHP and JavaScript language and distributed under the GNU General Public license. At the moment, Humanitas University is using the 3.6 version.

The platform was implemented to manage all the activities foreseen by the 6-year English medical degree course of Humanitas University. It contains all the 23 courses required by the study curriculum [FIG. 2] and the Portfolio activities with the corresponding Objective Structured Clinical Examination (OSCE).

The following tools are provided for each course:

- Announcements (not-threaded, asynchronous messages)
- Assignments

- Chat (synchronous conversation tool);
- Content Sharing (file storage space);
- Discussion (threaded, asynchronous messages);
- Syllabus.

|        | 1st SEMESTER  |  | 2nd SEMESTER  |
|--------|---|--|---|
| year 1 | Principles of the living matters (pLM)<br>Being a Medical Doctor (BMD)<br>The cell: molecules and processes (M&P)<br>Building bodies: from gametes to organs (BB) |  | The cell: molecules and processes (M&P)<br>Body architecture (BA)   |
|        |   |  | Introduction of professional activities   |
| year 2 | Body at work 1 (BW1)<br>Mechanisms of diseases (MOD)  |  | Body at work 2 (BW2)<br>Mechanisms of Diseases (MOD)  |
|        | Introduction of professional activities   |  | Introduction of professional activities   |
| year 3 | Communication skills (CSk)<br>Foundations for system diseases (fSD)<br>System diseases 1 (SD1)  |  | Communication skills (CSk)<br>System disease 2 (SD2)<br>Head and Neck (H&N)<br>Biotstatistic (BSt)  |
|        | Professional activities   |  | Professional activities   |
| year 4 | Communication skills (CSk)<br>System disease 3 (SD3)<br>Bone and Joint diseases (B&J)<br>ICT form medicine (ICT)  |  | Infectious diseases (ID)<br>Pathology (Pth)<br>Clinical immunology & Dermatology (CI&D)<br>Public health & environmental medicine (PhEvM) |
|        | Professional activities   |  | Professional activities   |
| year 5 | Patient mangement (PtMg)<br>Mental Health (MHe)<br>Clinical Neuroscience (CNsci)<br>Neuropharmacology (Nph)<br>Communication skills (CSk)                         |  | Patient management (PtMg)<br>Obstetrics & Gynecology (ObGY)<br>Pediatrics (Pd)<br>Oncology(Onc)   |
|        | Professional activities   |  | Professional activities   |
| year 6 | Patient Management (PtMg)<br>Emergencies (ER)<br>Forensic Medicine (FMd)  |  | Thesis  |
|        | Professional activities   |  |   |

**Fig. 2:** Medical study plan at Humanitas University.

Thanks to the flexibility of technology we succeed in organizing special course pages for Portfolio activities (simulations, case discussions, clerkships). Access to LMS is provided via user id and password. Through the dashboard, all the Portfolio activities for each academic year and for each semester can be viewed, in addition to the educational function provided by an LMS platform, whose description is beyond the aim of this article.

We succeed to adapt and interact with Moodle in order to develop an external interface *Pannello Segreteria* for Student Office where to manage groups and subgroups of students who participates to the activities, plan activities day by day and manage student attendances.

A member of the student office can easily work on interface filtering all the data by course, activity, group, subgroup, student and date. They can duplicate, edit and delete a date assigned to an activity.

In the database, which is structured in different correlated tables, we can track all the activities related to Portfolios program. We embedded inside LMS pages assessment forms for every activity with their own specific rules, allowing tutors to provide evaluations using a score ranging 0 to 4 and also considering missing evaluations [FIG. 5]

We created a calculation system considering OME rules and where all the scores achieved by students in the several activities are converted to a final grade. Eventually we created the Global Assessment windows where teachers can view all

the final grades and average scores of the Portfolio for each semester and have a better understanding of the overall student progress over time.

Every activity related to the portfolios is accessible with different rights and restrictions to the tutors who manage their activity and to the students that were assigned to. All the activities are accessible to the Portfolio supervisors and to the Student Office members. Training in the use of the LMS is not required for faculty or students, although the university IT offer voluntary training sessions for instructors. The LMS platform is uniformly accessible across the institution.

**Sotto Gruppi**



























In questa pagina vengono creati dei sotto gruppi collegati ai macro gruppi, potrai filtrare gli elementi per corso, per macrogruppo e per nome. Nel campo di ricerca del corso, verrà caricata una lista cliccabile con i corsi che hanno **almeno 1** gruppo associato. Cliccando sul nome delle colonne potrai ordinare.

Nome

Portfolio 5th year - 3rd Cohort 2020/21

Filtro per Macrogruppo

Filtro per Sottogruppo

| Colore | Corso                                   | Macro Gruppo - ?              | Sotto Gruppo                 | Gestisci  |
|--------|---|-------------------------------|------------------------------|---|
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 1 Red Group Scenario         |       |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 2 Red Group Scenario         |       |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 1 A Red Scenario Group       |       |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 1 B Red Scenario Group       |     |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 1 C Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 1 D Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 1 E Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 2 A Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 2 B Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 2 C Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 2 D Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 2 E Red Scenario Group       |   |
| ●      | Portfolio 5th year - 3rd Cohort 2020/21 | V Year 3rd Cohort 2020/21 Red | 1 Yellow 1st Cohort Scenario |   |

**Fig.3:** an example of LMS "Pannello Segreteria" (Student Office view only): the system is able to plan activities day by day and manage student attendances with upload function for certification of justified absence.

We created Portfolio categories, which directly relate to each new year academic year. At the moment, there are 5 categories, since 2014 when Portfolio activities were first implemented on LMS.

Every year a new category is added, and it is composed Portfolio pages for the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> year of medicine. Inside each category we have divided the portfolio activities in semesters and type of activity [TABLE 1-2].



## ATTENDANCE PANEL

Use this panel to indicate presence.

Activity name: History taking skill lab

Group name: Green group - May, 2

Period: 02/05/2017-02/05/2017

| USERS                 | ATTENDANCE                               |   |  | FEEDBACK                        |
|-----------------------|--|---|--|---------------------------------|
| AGNELLI ANGELICA      | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| CHERSI FILIPPO        | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| DE SENSI ALICE GIULIA | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| DI MAIO MARCO         | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| FAMI AMITA            | <input type="radio"/> Present            | <input checked="" type="radio"/> Absent | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| GAMBILLARA GAIA       | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| GRANONE VERONICA      | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| LASAGNA CHIARA        | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| RICCIARDI BEATRICE    | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |
| TAGLIAFERRI VALENTINA | <input checked="" type="radio"/> Present | <input type="radio"/> Absent            | <input type="radio"/> Justified Absent | <a href="#">Review Feedback</a> |

RETURN TO ACTIVITY

**Fig.4:** an example of LMS Attendance Panel (tutor and student view): the system is able to record students' attendance, to record the presence of documented justified absence; in this case LMS automatically moves the student to the recovery group, allowing the rescheduling of the activity. If the absence is not justified, the system automatically fills in the evaluation form with a negative (not evaluable) vote.

## Assessment on History Taking (content and conduction)

Tutor: Liola Montagna - Vanda Bianco

Student: ANGELICA AGNELLI

Year: 2016/17

Semester: 2

| Professional behaviour   |                         |   |   |   |  |
|--|-------------------------|---|---|---|--|
| Professional values  | Not evaluable           | Failure   | Marginal competence   | Good  | Excellent  |
| <b>Compassion</b><br><small>Evaluated by Liola Montagna</small>                | <input type="radio"/> 0 | <input type="radio"/> 1<br>Disrespectful and insensitive to patient's needs                         | <input type="radio"/> 2<br>Lack of empathy Unconcerned to the patient's needs   | <input type="radio"/> 3<br>Demonstrate high degree of empathy, appropriately respectful   | <input checked="" type="radio"/> 4<br>Outstanding commitment to compassion and always respectful and concerned |
| <b>Integrity and Reliability</b><br><small>Evaluated by Liola Montagna</small> | <input type="radio"/> 0 | <input type="radio"/> 1<br>Uninterested, always late, passive, incomplete histories, disorganized   | <input type="radio"/> 2<br>Requires frequent structuring  | <input checked="" type="radio"/> 3<br>Punctual, well-motivated, follows through on assigned tasks                               | <input type="radio"/> 4<br>Outstanding commitment to honesty and integrity, works independently                |
| <b>Commitment to learn</b><br><small>Evaluated by Liola Montagna</small>       | <input type="radio"/> 0 | <input type="radio"/> 1<br>No effort in self-directed learning, resistance to constructive feedback | <input checked="" type="radio"/> 2<br>Poor effort in self-directed learning, lack in searching appropriate resources, poor effort in accepting appropriate feedback | <input type="radio"/> 3<br>Appropriate self-directed learning, accepts constructive feedback, good use of appropriate resources | <input type="radio"/> 4<br>Excellent use of resources, recognized own strengths and limitations                |
| <b>Narrative comments</b><br><small>Evaluated by Liola Montagna</small>        |                         |   |   |   |  |

**Fig. 5:** an example of LMS Assessment form: the professional behavior evaluation form for the History taking activity is displayed. The tutor can view the description of the evaluation and choose a score between 0 and 4 for each item on the form (Not evaluable, Failure, Marginal competence, Good, Excellent). Tutor can also add a narrative comment for the student.

**Table 1 -** Activities, tutors and students involved in professional activities considering 2018-19

| Year of Portfolio          | Nr. of activities   | Tutor involved | Students involved |  |
|----------------------------|---|----------------|-------------------|--|
| Portfolio 3 <sup>rd</sup>  | 1 <sup>st</sup> semester:<br>8 <i>simulations and case discussions</i><br>+ 36 <i>clerkships</i><br>2 <sup>nd</sup> semester:<br>9 <i>simulations and case discussions</i><br>35 <i>Clerkship</i> | 93             | 134               |  |
| Portofolio 4 <sup>th</sup> | 1 <sup>st</sup> semester:<br>9 <i>simulations and case discussions</i><br>+ 30 <i>clerkships</i><br>2 <sup>nd</sup> semester:<br>7 <i>simulations and case discussion</i><br>36 <i>Clerkship</i>  | 97             | 102               |  |
| Portfolio 5 <sup>th</sup>  | 1 <sup>st</sup> semester:<br>1 <i>examination and 1 scenario</i><br>+ 38 <i>clerkships</i><br>2 <sup>nd</sup> semester:<br>--   | 52             | 95                |  |

**Table 2 :** Activities, tutors and students involved in professional activities during 2019-20 (\*2nd semester was affected by Coronavirus Pandemic).

| Year of Portfolio          | Nr. of activities   | Tutor involved | Students involved |  |
|----------------------------|---|----------------|-------------------|--|
| Portfolio 3 <sup>rd</sup>  | 1 <sup>st</sup> semester:<br>9 <i>simulations and case discussions</i><br>+ 40 <i>clerkships</i><br>2 <sup>nd</sup> semester:<br>8 <i>simulations and case discussions</i><br>35 <i>Clerkship</i> | 93             | 144               |  |
| Portofolio 4 <sup>th</sup> | 1 <sup>st</sup> semester:<br>9 <i>simulations and case discussions</i><br>+ 29 <i>clerkships</i><br>2 <sup>nd</sup> semester:<br>7 <i>simulations and case discussion</i><br>36 <i>Clerkship</i>  | 82             | 129               |  |
| Portfolio 5 <sup>th</sup>  | 1 <sup>st</sup> semester:<br>1 <i>examination and 1 scenario</i><br>+ 45 <i>clerkships</i><br>2 <sup>nd</sup> semester:<br>--   | 59             | 97                |  |

## Study design

An evaluation questionnaire on LMS was submitted to all members of the OME (7 members) and the Student Office (2 members). In addition, the university register's office provided a quantitative evaluation of the working hours by the members of OME. The data obtained assessed the reduction of the number of work hours by the members of OME and Student Office regarding organization, management and assessments of E-Portfolio on LMS compared with Portfolio before LMS.

The aim of the study is to obtain data about OME and Student Office Member perception of the most valuable benefit from using LMS in term of improve organization, management and evaluation system of the professional activities.

The techniques used for evaluating the usability of learning management systems have varied from simple checklists to more complicated standardized questionnaires. Many research studies have been conducted to evaluate the usability of existing learning management systems.

Based on the Shackel's proposal usability<sup>14</sup> practicality of LMS can be viewed in terms of four major operational criteria: effectiveness, learning ability, flexibility and attitude.

This study involves the testing of all four operational criteria on learning management system.

- Effectiveness – The performance in accomplishment of tasks by the percentage of the users within the system
- Learning ability – The degree of learning to accomplish tasks.
- Flexibility – The adaptation to variation in tasks and environments which can be accommodated by the design.
- Attitude – The user satisfaction with the system and continuation in its use or suggestions for improvements.

We choose to use a System Usability Scale (SUS) because is a simple, ten-item attitude scale giving a global view of subjective assessments of usability [TABLE 3]. It was developed by John Brooke<sup>15</sup> in 1986 as a tool to be used in usability engineering of electronic office systems.

**Table 3:** List System Usability Scale (SUS) question.

| Question  | Strongly disagree     |                       | Strongly agree        |                       |                       |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|   | 1                     | 2                     | 3                     | 4                     | 5                     |
| 1. I think that I would like to use LMS frequently.                                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 2. I found LMS unnecessarily complex.   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 3. I thought LMS was easy to use.   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 4. I think that I would need the support of a technical person to be able to use LMS. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 5. I found the various functions in LMS were well integrated.                         | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 6. I thought there was too much inconsistency in LMS.                                 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 7. I would imagine that most people would learn to use LMS very quickly.              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 8. I found LMS very cumbersome to use.  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 9. I felt very confident using LMS.   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 10. I needed to learn a lot of things before I could get going with LMS.              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

## 3 Results

Table 4 displays the overall response of 9 members of Office for Medical Education and Student office to each question in SUS questionnaire as average response which varies from 1 to 5 [TABLE 4].



**Table 4:** average score of OME and Student Office response for each question in SUS.

| Question  | Average score |
|---|---------------|
| 1. I think that I would like to use LMS frequently.                                   | 4.9 ± 0.3     |
| 2. I found LMS unnecessarily complex.   | 1.7 ± 0.3     |
| 3. I thought LMS was easy to use.   | 4.1 ± 0.3     |
| 4. I think that I would need the support of a technical person to be able to use LMS. | 4.2 ± 0.7     |
| 5. I found the various functions in LMS were well integrated.                         | 4.7 ± 0.3     |
| 6. I thought there was too much inconsistency in LMS.                                 | 1.3 ± 0.5     |
| 7. I would imagine that most people would learn to use LMS very quickly.              | 3.9 ± 0.6     |
| 8. I found LMS very cumbersome to use.  | 1 ± 0         |
| 9. I felt very confident using LMS.   | 4.1 ± 0.3     |
| 10. I needed to learn a lot of things before I could get going with LMS.              | 1.73.9 ± 0.6  |

The average response to the positive statements 1,3,5,7 and 9 were above midpoint, suggesting that LMS@Hunimed is easy to use, that its functionalities were designed properly and were well integrated. On an opposite note, the responses to the negative statements 2, 4, 6 and 8 allowed the evaluation for further interface improvement, as some complexities and irregular actions in its functionalities, or rather doubts in how to use the new portfolio management system, were found. Data concerning the reduction of working hours are shown in the table 5.

**Table 5:** working hours (mean±standard deviation) on Portfolio activities of members of OME and Student Office before and after LMS implementation.

|                     | Before LMS E-Portfolio | With LMS E-Portfolio |
|---------------------|------------------------|----------------------|
| <b>Organization</b> | 16.3±2.3               | 4±0.5                |
| <b>Management</b>   | 5.1±1.2                | 2.3±0.9              |
| <b>Assessment</b>   | 33±2.3                 | 4±0.5                |

## 4 Discussions

The online portal becomes a place where students can confidently search and obtain information regarding their courses, as well as obtaining all learning materials teachers share on the same platform<sup>16</sup>. The effectiveness of LMS has led to its adoption by various universities all over the globe<sup>2</sup>.

One of the strengths of LMS in general is certainly flexibility, perceived as the ability to adapt to the course of study. In particular, this statement is particularly true if we consider the complexity and uniqueness of Humanitas University's portfolio of professional activities. From a first analysis of the collected data it is possible to highlight not only a good feedback on the usability of LMS, but also a marked improvement in terms of time dedicated to the organization, management and assessment of the Portfolio of professional activities and better traceability and archiving system for assessments and didactic material produced by the student during the semester.

As we have seen, LMS @ Hunimed not only plays a supporting role for the didactic management of the courses, but, from its first implementation, it has also been the space in which to manage and evaluate professional activities performed by students.

The 6-year curriculum of Humanitas University [FIG. 2] requires that medical students begin professionalizing activities for the development of transversal clinical skills, considered fundamental for the professionalism of the doctor from the first semester of the 3rd year of the course up to the 5th year, first semester. During these years, professionalizing activities are mandatory, structured and managed directly by OME according to objectives focused on the development of clinical skills and integrated with the courses of the academic years.

These activities are integrated with the courses of the clinical years, through the development of transversal skills (anamnesis and physical examination) in relation to the pathologies studied in the courses. All activities result in an Activity Portfolio and are assessed each semester through a final OSCE. Finally, Portfolio and OSCE generate a final score that mediates in the evaluation of clinical exams (SD1, SD2, SD3), helping to define the profile of the skills acquired by the student in the clinical years which it is presented at the 6th Patient management exam year. Each tutor has access to LMS@Hunimed through the credentials provided by the University. In this way they can directly know the students' training path, read the syllabus of the courses and have access to the specific session of the assigned activity. In this session the tutor can find the list of groups or individual students according to the activities in which he is involved. The system allows the guardian to detect the student's attendance in the activities, which is mandatory to have access to the correction of the students' Portfolio materials and to evaluate their activities, by filling in the computerized evaluation forms.

The OSCE exam is also managed digitally. During the OSCE session, in addition to each room being set up with the materials required by the chosen test, the tutor evaluates the student directly by connecting to the check list previously loaded in the OSCE session prepared on LMS @ Hunimed. This organization allows at the end of each session to have a direct OSCE final score, which is then added to the scores achieved in the final Portfolio to generate the overall grade (+3; -3). The last overall grade will be added to the final exams of the System Disease courses.

The concrete help of LMS@Hunimed is based on two elements:

- the presence of a secretarial panel from which the Student Office can manage the calendar of activities for each individual student, record attendances, archive disease certificates and simultaneously automatically reschedule recovery days and assessments in case of unjustified absence;
- the evaluation of the activities takes place in such a way as to guarantee the complete traceability of both the didactic material uploaded to the system by the student, and the tutor's comments and grades. Such results automatically enter in a wider system of professionalizing e-portfolios that is used by the teachers in order to elaborate the final exam grade for those exams related to the same professional activities (eg System Diseases, Patient Management, etc).

This system has had huge advantages compared to the pre-IT era for the members of the OME who have compiled the usability questionnaire. This is because this method saves a lot of time in terms of organizing activities and correcting individual portfolios, increasing efficiency secretarial work, reducing the human error related to the manual calculation of the scores and the translation into the grades and increasing the traceability of the teaching activities that remains quickly and immediately available to students and tutors. The above mentioned improvements in work efficiency are depicted by data in Table 5, which shows significant decrease in working hours of  $12.3 \pm 2.8$ h for organization tasks,  $-2.8 \pm 2.1$ h for management tasks and  $-29 \pm 2.8$ h for assessments tasks. Furthermore, a qualitative analysis of the System Usability Scale (SUS) questions showed that teachers felt confident to use LMS in their daily and future activities and believe that LMS is a easy tool to learn and effective for its implemented functionalities (Table 4).

The advantage of a flexible IT system compared to a more rigid system also allows to modulate the didactic offer according to the student's individual parameters such as health or family needs. In such circumstances, unattended activities are automatically rescheduled into a future time slot. LMS automatically groups together all students who have missed mandatory attendances and proposes available tutors for supervision. This allows students to be more flexible in their planning and tutors to avoid the time consuming traditional rescheduling processes.

Differently from other systems, the LMS@Hunimed is specific to the medical setting, where students are required to attend a variety of educational activities from different frontal lectures. LMS supports the integration and organization into clinical practice, as it grants students full access to resources, guides and schedules to attend PBLs, group activities and clerkship rotations.

LMS also assume a relevant position in communication. It represents a useful solution used by both students and teachers, as it promotes interactions among students and also along with teachers on personal and collective levels. LMS, in fact, offers different tools for effective communication, such as Q&A dedicated web pages visible to the whole class and messaging apps for instant, private messages. By such means, students are eager to address specific questions and doubts about lecture contents and have the ability to share them with the whole class to be seen. On the other side, teachers are also able to communicate privately or collectively with all class members and further improve teaching methods. LMS supports management tools that tracks, examine and plan lectures, resulting in a detailed statistical analysis which help teachers in developing effective teaching methods.<sup>6</sup>

## 5 Conclusions

LMS@Hunimed therefore represents a substantial tool of support to the training device of Humanitas University, not only for the organizational aspects supporting practical activities, but also for the creation of a space for communication and concrete didactic collaboration between the University and the Hospital, aiding the project of a university teaching hospital. The rising of technological innovations is inevitable and universities should already integrate such tools in support to their teaching methods and to communication. An university web-based portal offers a functional direct access to messaging tools for communication which will outclass the more traditional in person interactions in the immediate future. On such basis, LMS@Hunimed was developed with the idea of creating a space where teaching contents could be supported and implemented with additional digital sources. Additionally, the automatizations of managerial and organizational tasks allows LMS@Hunimed to improve quality of work for OME and Student Office, increase traceability and monitoring of tutor and students activity and reducing human mistake in evaluation and organization. LMS@Hunimed can be, therefore, considered as an important investment for the future and progress of universities.

## References

- [1] Hawkins, B. L., & Rudy, J. A. (2007). Educause core data service. Fiscal year 2006 summary report. Boulder, CO: Educause.
- [2] Koszalka, T. A., & Ganesan, R. (2004). Designing online courses: A taxonomy to guide strategic use of features available in course management systems (CMS) in distance education. *Distance Education.*, **25**(2), 243–256(2004).
- [3] Becker, R., & Jokivirta, L., (2007). Online learning in universities: Selected data from the 2006 Observatory survey – November 2007. The observatory on borderless highereducation (OBHE). [Electronic Version] <<http://www.obhe.ac.uk>> Retrieved 15.03.09.
- [4] Hanson, P., & Robson, R. (2004). Evaluating course management technology: A pilot study. Boulder, CO: EDUCAUSE Center for Applied Research, Research Bulletin., **(24)**, (2004).
- [5] Phyllis A. Guze, Md, Macp (2015). Using Technology to meet the challenges of Medical Education Transactions of the American Clinical And Climatological Association., **126**. 260-270(2015).
- [6] Hong, KS & Ridzuan, AA & Kuek, MK. (2003). Students' attitudes toward the use of the Internet for learning: A study at a university in Malaysia. *Educational Technology & Society.*, **6**. 45-49(2003).
- [7] West, R. E., Waddoups, G., & Graham, C. R. (2007). Understanding the experiences of instructors as they adopt a course management system. *Educational Technology Research and Development.*, **55**(1), 1–26(2007).
- [8] Dutton, W. H., Cheong, P. H., & Park, N. (2003). The social shaping of a virtual learning environment: The case of a university-wide course management system. *The Electronic Journal of e-Learning.*, **2**(1), (2003).
- [9] D.A. Back, F. Behringer, N. Haberstroh, J. P. Ehlers, Kai Sostmann, Harm Peters (2016). Learning management system and e-learning tools: an experience of medical students' usage and expectations *International Journal of Medical Education*. DOI: 10.5116/ijme.57a5.f0f5., **7**, 267-273(2006).
- [10] Bosch, C. (2016). Promoting Self-Directed Learning through the Implementation of Cooperative Learning in a Higher Education Blended Learning Environment. Johannesburg, SA: Doctoral dissertation at North-West University
- [11] Thea Haldane: “Portfolios” as a method of assessment in medical education. *Gastroenterol Hepatol Bed Bench*. 2014 Spring., **7**(2), 89–93(2014).
- [12] Challis M. AMEE medical education guide no. 11 (revised): Portfolio based learning and assessment in medical education. *Medical Teacher.*, **21**, 437–40(1999).



- [13] Roberts C, Newble DJ, O' Rouke AJ. Portfolio based assessments in medical education: are they valid and reliable for summative purposes? *Med Edu.*, **36**, 899–90(2002).
- [14] Shackel, B. (1991). Usability--context, Framework, Definition, Design and Evaluation. Shackel, B. and Richardson, S., Ed. *Human Factors for Informatics Usability*. pp.21-37. Cambridge, UK, Cambridge University Press
- [15] Brooke, J. (1986). "SUS: a "quick and dirty" usability scale". In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & A. L. McClelland (eds.). *Usability Evaluation in Industry*. London: Taylor and Francis.
- [16] Steven Lonna, Stephanie D. Teasleyb. Saving time or innovating practice: Investigating perceptions and uses of Learning Management Systems. *Computers & Education.*, **53(3)**, 686-694(2009).