Usage and Effectiveness of E-Learning Courses for Continuous Medical Education

M. Cristina MAZZOLENI a,1, Carla ROGNONI b, Enrico FINOZZI a, Ines GIORGI a, Franco PUGLIESE c, Mauro LANDRO d, Marcello IMBRIANI a

a S. Maugeri Foundation IRCCS, Scientific Institute of Pavia, Italy
b Department of Computer Engineering and Systems Science, University of Pavia, Italy
c Department of Prevention and Protection – AUSL of Piacenza, Italy
d CBIM – Consorzio di Bioingegneria e Informatica Medica, Pavia, Italy

Abstract. The paper describes the results of an e-learning experimental project for Continuous Medical Education (CME) in Occupational Medicine in terms of: extent of the e-learning courses usage by the healthcare personnel, knowledge acquisition and satisfaction. 11 courses have been available for 11 months during which 2,034 users all over Italy enrolled in 5,183 courses with a success percentage of 72% and a significant difference between test scores performed before and after attending the e-learning courses. Also user’s satisfaction, inspected through a questionnaire, has provided good results. Starting from the experience reported, the authors are confident that e-learning will gain ground and evolve as an effective and appreciated educational mean for CME.

Keywords. e-learning, continuous medical education, occupational medicine

1. Introduction

Continuous Medical Education (CME) delivered through distance learning is under evaluation in Italy since few years ago. Some experimental projects have been developed in order to find an answer to the question: Is distance learning, and e-learning in particular, an effective educational mean on which it is worth reckoning and investing at national level? Aim of the present paper is to evaluate the results of the experimental project in Occupational Medicine for healthcare personnel in terms of: extent of the e-learning platform usage and of course attendance, knowledge acquisition, and satisfaction of the attendees.

2. Materials and Methods

The e-learning system, described in detail in [1, 2], is available on-line free of charge since the end of December 2007. It is based on Moodle (www.moodle.org) platform

1 Corresponding Author: Cristina Mazzoleni Fondazione Maugeri, Via Maugeri 4 – 27100 Pavia Italy; E-mail: cristina.mazzoleni@fsm.it.
2 e-learning: Web-based training whose contents are integrated into a learning management system (platform) that allows activity tracing, interaction, and continuous evaluation of the learning processes.
3 Research was supported by “E-learning per la qualità della vita e la sicurezza in ambito lavorativo” project of Ministero della Salute and S. Maugeri Foundation, IRCCS.
and is characterized by a moderate level of technological requirements in order to reduce the risk of technical difficulties due to user lack of computer knowledge.

After registration to the e-learning platform, users can enroll themselves into the courses; 10 of them are specific for occupational physicians (OP): Professional asthma (PA); Pneumonia caused by allergens (PCA); Industrial noise (IN); Use of video terminals (UVT); Mechanical vibrations (MMT); Industrial solvents (IS); Ergonomics (E); Professional stress (PS); Risk management strategies (RMS). One course, patients handling (PH), is for nurses, physiotherapists and occupational physiotherapists (other healthcare personnel – OHP).

The educational model has been designed in order to provide for each course:

- An initial test (IT) to inspect initial knowledge of the user
- Information transfer via self-learning modules for free navigation at different levels and multi-level hyper-flowcharts of guideline-based decision processes
- Case-based tests, particularly effective [3] to reinforce the learning process
- Final test (FT) for the evaluation of the results of the learning process
- A satisfaction questionnaire

A tutor for each course is available for questions through a message exchange system embedded in the platform. The free of charge experimental period was set up till the end of October 2008; during this time a few updates were executed with the aim of improving the usability of the system and hence preventing user drop out due to possible scarce friendliness. Only five months after the beginning of the experimental phase, CME credits were officially attributed to the courses.

The usage of the system has been evaluated through: demographic, geographic and professional characterization of the users, statistics about the number of enrolments (per user, per course) and interactions with tutors. A minimum threshold of 1300 course enrolments (1000 for OPs and 300 for OHP) was defined as parameter to discriminate between failure and success of the experimental project.

Users' knowledge acquisition and satisfaction have been considered as indicators of effectiveness. Knowledge acquisition by the users has been evaluated in terms of number of passed courses and improvement of the score via the comparison between final and initial test. Perceived user's satisfaction and motivation to behavioural change have been investigated using a questionnaire (5 point Likert scale answers).

### 3. Results and Discussion

#### 3.1. Extent of Usage and User Characteristics

During the span of time of 11 months, 2,034 users (42% Male, 58% Female; 43% OPs, 19% Nurses, 33% Therapists, 5% Others) have registered to the e-learning platform and 1,804 of them enrolled themselves into at least one course, with a total number of 5,183 course enrolments. In comparison with the expected minimum number of 1,300 course enrolments, this represents a great success. The very great majority of the enrolments occurred only after the publiction of the CME accreditation.

The geographical distribution of the users shows a higher value for the North (66%), with respect to Central (19%) and South (15%) Italy. These figures are affected by many factors: 1) Promotion of the system was initially performed during workshops and courses and through a “pass the word” process, especially among nurses, having a
northern region as epicentre; 2) OPs are not uniformly distributed in the country; 3) Internet diffusion is not balanced among different Italian regions.

The total number of course enrolments follows a similar distribution: North (65%), Central (20%) and South (15%) Italy.

Taking age into consideration, Figure 1A shows the distribution of users. Category “Other” represents users different from OP and OHP, for which the courses are not accredited. The distribution points out that age is not a critical factor for the usage of the system, in line with [4] and over-fifty OPs represent a significant fraction. In terms of intensity of usage, measured as number of course enrolments for OPs, users aged over fifty seem to be very active. As shown in Figure 1B, 363 OPs (41%) enrolled to more than half of the available courses, and even 74 OPs enrolled to all of the courses plus the one for OHP, that does not provide them credits. 122 OPs have registered only to the platform without any course enrolment. The number of enrolments for user could be affected not only by the interest of the user, but also by the need of the user for gathering credits that is related to the number of credits already collected in the year.

**3.2. Knowledge Acquisition**

Table 1 describes the situation for each of the 11 courses. The great majority of the courses has been concluded with positive results. Success percentages for all of the 11 courses are greater than 70%, and this result is encouraging if compared with [5].

<table>
<thead>
<tr>
<th>COURSE</th>
<th>Active Users</th>
<th>Passed</th>
<th>Still Attending</th>
<th>Not passed</th>
<th>% passed</th>
<th>IT mean score</th>
<th>FT mean score</th>
<th>N° of Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA</td>
<td>470</td>
<td>371</td>
<td>91</td>
<td>8</td>
<td>78.9</td>
<td>60</td>
<td>89.3</td>
<td>37</td>
</tr>
<tr>
<td>PCA</td>
<td>280</td>
<td>221</td>
<td>51</td>
<td>8</td>
<td>78.9</td>
<td>58</td>
<td>93.16</td>
<td>3</td>
</tr>
<tr>
<td>PH</td>
<td>1104</td>
<td>831</td>
<td>263</td>
<td>10</td>
<td>75.3</td>
<td>62</td>
<td>91.67</td>
<td>48</td>
</tr>
<tr>
<td>MV</td>
<td>364</td>
<td>275</td>
<td>76</td>
<td>13</td>
<td>75.6</td>
<td>55</td>
<td>89.17</td>
<td>24</td>
</tr>
<tr>
<td>UVT</td>
<td>521</td>
<td>372</td>
<td>116</td>
<td>33</td>
<td>71.4</td>
<td>76</td>
<td>92.25</td>
<td>14</td>
</tr>
<tr>
<td>IN</td>
<td>444</td>
<td>332</td>
<td>94</td>
<td>18</td>
<td>74.8</td>
<td>60</td>
<td>88.16</td>
<td>12</td>
</tr>
<tr>
<td>MMT</td>
<td>432</td>
<td>342</td>
<td>83</td>
<td>7</td>
<td>79.1</td>
<td>67</td>
<td>92.86</td>
<td>7</td>
</tr>
<tr>
<td>IS</td>
<td>257</td>
<td>223</td>
<td>32</td>
<td>2</td>
<td>86.7</td>
<td>53</td>
<td>91.9</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>330</td>
<td>268</td>
<td>57</td>
<td>5</td>
<td>81.2</td>
<td>82</td>
<td>96.6</td>
<td>4</td>
</tr>
<tr>
<td>PS</td>
<td>407</td>
<td>294</td>
<td>106</td>
<td>7</td>
<td>72.23</td>
<td>44.5</td>
<td>85.48</td>
<td>14</td>
</tr>
<tr>
<td>RMS</td>
<td>245</td>
<td>181</td>
<td>64</td>
<td>0</td>
<td>73.8</td>
<td>48.5</td>
<td>89.17</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>4854</td>
<td>3710</td>
<td>1033</td>
<td>111</td>
<td></td>
<td></td>
<td></td>
<td>166</td>
</tr>
</tbody>
</table>

Considering all of the users who have positively concluded a course and comparing the results of the pre-course and post-course tests for each course, there has
been a statistically significant improvement in terms of knowledge acquisition for all of the courses as shown by the data in Table 1. Due to the small size of the samples of users who have not positively concluded the courses, no evaluation is possible as to their knowledge enhancement.

Since the final aim of the project was to transfer competencies to users, the results of the tests, and case-based tests in particular, were monitored in order to understand on the run if and where people had difficulties. From the analysis of the answers of the exercises, some criticalities have been identified and some changes have been applied to the content of some courses. This intervention has proved to be effective, and has contributed to the positive results in terms of knowledge acquisition. Effectiveness of e-learning versus lecture-based education in terms of knowledge acquisition has been inspected as to PH course [6], and both the educational methods provided good results, in line with [7].

Quite disappointing, on the contrary, has been the interaction with the tutor. Common sense could lead to a justification like “people don’t like it” or “contents and exercises were clearly understandable”. A thorough analysis is necessary and it will be carried out as next step.

Figure 2 relates the number of positively concluded courses with the number of course enrolments per user, as on October 31st. Among the 228 users who have enrolled to at least one course but have positively concluded zero courses, 79 users have only previewed the system, not being really interested in attending the educational sessions. 80 out of 228 users have enrolled only, at maximum, two weeks before October 31st, so they might have concluded the course later, out of the observation interval. A more detailed analysis of this entire group of users is ongoing.

![Figure 2. Frequency scatterplot of positively concluded courses versus course enrolments (OPs and OHP)](image)

3.3. User's Satisfaction

User's satisfaction of the e-learning courses has been pretty good. Table 2 shows the results driven from 4,047 questionnaires as to the aspects related to perceived educational quality. The sample is hence composed of the questionnaires filled by all of the users who have positively concluded (3,710), but also by some users (337) who have not finished or not passed the course. The reported values are the average percentages, calculated taking into account all of the 11 courses.

One of the most important aspects that should be inspected when dealing with CME, and distant CME as well, is the capacity of inducing positive changes in practice
The last item of Table 2 points out good results, but at the moment only subjective perspective data are available.

Table 2. Satisfaction questionnaire answers

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Moderate</th>
<th>Sufficient</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance of the topics</td>
<td>0%</td>
<td>2%</td>
<td>28%</td>
<td>48%</td>
<td>22%</td>
</tr>
<tr>
<td>Quality of the educational model</td>
<td>0%</td>
<td>2%</td>
<td>19%</td>
<td>53%</td>
<td>26%</td>
</tr>
<tr>
<td>Motivation to behavioural changes</td>
<td>1%</td>
<td>4%</td>
<td>27%</td>
<td>48%</td>
<td>20%</td>
</tr>
</tbody>
</table>

4. Conclusions

The results of an experimental project are reported, with special focus on the usage and the effectiveness of the e-learning system that has been developed. A comparison of the results with others from the literature is not easy. A certain number of papers [9] have been published about “internet CME activities”, but this expression is very broad and is not always used as synonym for e-learning. Anyway positive conclusions, or more often optimistic expectations, are reported as regards web-based education, even in the field of Occupational Medicine [7]. The present study hence supports, with experimental data collected in a controlled context such as the one of an e-learning platform, the usefulness of reckoning and investing on this technology and methodology for CME at national level. Some lessons have been learnt: continuous monitoring of the behaviour of the users in terms of both usability evaluation and results of the learning process is a necessary useful activity; moderate technological requirements are a facilitator to massive usage, not a problem or an indicator of low quality. Some questions are still open: what will happen in case the courses are not free of charge? How to improve the interaction between users and tutor?

Starting from the experience here reported, the authors are confident that e-learning will continue to gain ground and evolve as an effective and appreciated educational mean for CME.

References