Development of an E-learning System for Occupational Medicine: Usability Issues

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Abstract. The aim of the present paper is to describe the process of developing an e-learning system for continuous medical education in the field of occupational medicine, with special focus on usability. The following steps are described: the needs analysis of the potential users; the prototype of the system that has been set up; the usability evaluation of the prototype by a sample of ten users; the analysis of the potential improvements; the evaluation of the revised system. The results of the usability tests point out that investing in improving usability was useful, even when they have not been recommended as mandatory. Only data collected from real active users will provide a more exhaustive evaluation, nevertheless it can be considered that positive results can be expected.

Keywords. e-learning, usability, education, occupational medicine

Introduction

As a consequence of the continuous technological and organizational changes of industrial production activities, occupational medicine ever increasingly needs a systematic and timely realignment of its scientific basis and intervention methods.

Moreover, in the last few years, occupational medicine physicians have been facing supplementary tasks, with respect to the clinical ones: they have the role of being consultant for risk assessment and management, information and education of workers, and the management of bureaucratic and legal issues. E-learning tools could support physicians to keep up to date with these dynamic changes. Continuous medical education (CME) through the internet has become popular [1] in some countries. Literature reports an interesting project [2] in the occupational medicine field, even though it was aimed at undergraduate students. In Italy, there is at present a certain drive in order to make e-learning for CME to take off. Even though a normative framework for distance CME has not been completely defined yet, some experimental

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projects are on-going with a twofold aim: the first, obviously, to support mandatory continuous medical education, and the second to try to overcome healthcare personnel skepticism as to e-learning.

When dealing with the introduction of computer based systems for healthcare personnel, user acceptance is often quoted as a critical issue, and e-learning systems are not an exception [3]. System usability and user acceptance are in direct causal relationship.

The aim of the present paper is to describe the process of developing and implementing an e-learning system for continuous medical education in the field of occupational medicine, with special focus on usability evaluation. The steps that have been undertaken in order to provide an e-learning tool that could be appreciated, and hence widely used, by the healthcare personnel are here described. In particular, the paper deals with: the needs analysis of the potential users; the description of the prototype of the system that has been set up; the usability evaluation of the prototype; the analysis of the identified criticisms and the evaluation of the revised system.

1. Methods

1.1. Needs analysis and educational model identification

ISO (International Standards Organization) defines usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”.

From this definition, the identification of the needs of the target user group represents the mandatory starting point of the project itself, in terms of both topics to be treated as well as goals to be achieved. For this purpose a focus group, composed of experts in the field of occupational safety and health, has been created. The discussion inside the focus group led to the definition of a 15 item questionnaire, containing the topics related to both risk factors (mechanical vibrations, noise, carcinogenic agents, etc.) and specific aspects of the routine activity of an occupational physician (job suitability, communication, legal issues, etc.).

The questionnaire was distributed to 300 potential users to obtain the necessary information about the perceived educational needs and preferences. The analysis of the answers provided the identification of a subset of risk factors to be dealt with by the e-learning system. At the same time it revealed, as expected since the target group is composed of adults, a specific interest for real problem solving oriented issues, more than issues of acquisition of knowledge per se.

Consequently, the educational model has been designed in order to provide:

- Information transfer via self-learning modules for free navigation.
- Schematic representations of guide lines based behavioural paths, through hyper-flowcharts to improve knowledge transfer into clinical practice [4].
- Ad hoc case studies. They are particularly effective [5] in order to reinforce the learning process. Here they are aimed at testing the knowledge and the acquired ability in solving specific problems addressed by the above mentioned behavioural paths.
- Evaluation of the results of the learning process through traditional tests (questions with multiple choice answer).

Excluding the possibility of direct face to face interaction between teacher and learner,
but considering communication as a must in self-learning models, the figure of a tutor has been introduced into the educational model. He or she has the specific tasks of supporting the continuity of the learning process, and of giving further explanations and details according to the learner’s requests.

1.2. The system

The e-learning system [6] has been developed using the course management system Moodle (Modular Object-Oriented Dynamic Learning Environment) [7] that is an open source package, designed using sound pedagogical principles, to produce internet-based courses and websites. Moodle uses SCORM (Sharable Content Object Reference Model) compliant modules [8].

The course list page shown in Figure 1 provides general information about the available courses with information and indications about the use of the system. After the registration to the website, users can enrol themselves into the proposed courses that are composed of different modules: tests, information modules, schematic representations of guidelines and ad hoc case studies. While test functionalities are embedded in Moodle, the other SCORM compliant modules have been implemented using different e-learning courses authoring tools, in particular WBTExpress for information modules, Saba® Publisher for case studies and Microsoft Visio for guide lines representation. More information is provided in [9].

1.3. Usability testing

Usability has been evaluated in two phases: analysis of ease of use and intelligibility of basic functionalities (BF) and inspection of the subjective usability perception (SUP).

As far as BF is concerned, 10 users (occupational physicians, mean age 45, range 29 - 58) were enrolled for this evaluation. Two issues were assessed: intelligibility of provided information, and the ease to complete the tasks. The test was performed by the users in absence of any previous information about the system. A usage test was structured in order to:

- Verify that the users have understood: role of the pre-test (IT), how to earn CME credits (IE) and get general courses information (IG); the effects of web site registration (IR), relationship between web site and course registration
Check the accomplishment of the tasks as to: course registration (TR), visualization and printing of one hyper-flowchart (TS), interaction with the tutor (TM), visualization of the educational offer (TC) and of the course content (TI). Only one attempt was allowed.

During the usage test session, each user, filled in a specifically prepared form in order to verify the completion of the tasks and the correctness of the information he or she had understood. In the meantime, an experienced observer recorded the comments of the user as well as personal observations.

As to SUP, the Software Usability Measurement Inventory (SUMI) [10] has been used. It is a consistent tool to assess the quality of use of a software product from the user’s point of view. It consists of 50 statements that the user has to answer. SUMI contains five sub-scales: Efficiency - support for the user to enable the user to get their work done, Affect - likeability, stress-free usage of the product; Helpfulness - degree of information about the product in the product itself; Control - amount of transparency as perceived by the end user; Learnability - ease with which a user can pick up how to use the software; and a Global scale. The raw scores obtained from the users are compared to the appropriate normative tables by SUMISCO software. In general, if some of the sub-scales are equal to or below 50 then they are poor in usability in that aspect. Sub-scales equal to or below 40 indicate the need for remedial action. Good software will achieve scores of 60 or more in most of the sub-scales.

At the end of the previously described BF usage test, each user has been asked to fill in the SUMI questionnaire.

2. Results

Figure 2 shows the rate of success for each dimension of the BF usage test. Figure 3 shows the SUMI scores results. All of the SUMI sub-scales, except “helpfulness - degree of information about the product in the product itself”, had a mean value equal to or greater than 50, and hence, according to SUMISCO, remedial actions were not strictly necessary. On the other hand, the BF test results showed some heavy criticisms, particularly as to TS, TM, IG, and II.

A further revision effort has been planned based on both the results of the BF test and of the expert recorded observations, therefore four kinds of remedial actions have been identified:

- Lexical related actions (L) – for example: to change the word “indice (contents)” into “contenuti (topics)” when referring to the list of contents.
- Layout related actions (S) – for example to change the column order in the table containing the course list.
- Procedure related actions (P) – for example to let the learner get in touch with the tutor during course navigation, instead of from the course list.
- Poor information related actions (I) – for example add specific information to improve the explanation of images and symbols.

In total 34 – respectively 13 (L), 4 (S), 10 (P) and 7 (I) – interventions have been identified as potentially useful.

The BF and SUP tests were performed again, using the same sample of users, on the revised system in order to quantify the improvement.
Figure 4 and 5 above show the final results: SUMI scores have reached values typical of “good software”. An improvement of the system is documented also by BF test results, even though some of the percentages of success are lower than 100%.

3. Discussion and conclusions

The evaluation presented here shows that the efforts aimed at improving usability of the prototype software has led to good results. However further remarks are necessary. First of all the dimension of the sample: a sample of ten users is reported as “adequate” for usability studies [10, 11], but a larger group of test users would be desirable to attain more comprehensive results and to assess differences related to age, familiarity with computers, and so on.

Second: within the BF second test, rates of success for IG and TS were still quite low: for both cases it is suspected that this is due to misinterpretation of the question rather than to a problem of the system itself. In the case of TS for example, the task was “Open and print the schema of the diagnostic pathway for occupational asthma”. Many of the users didn’t accomplish the task at the first attempt because they used the “print” icon of the browser instead of the proper “print the schema” button available within the page. This occurred again even after the button had been moved to a more visible position, and the description had been changed to a more intelligible one. In a real situation, when a user opens the schema, probably he/she spends some time looking at the page content, and hence has the possibility to realize that there is a specific print button. The right task description should have been “Open the schema,
answer a question related to the content, and print the schema”.

Third: Only the usability of the basic functionalities of the system have been evaluated. An evaluation on a wider scale is advisable, but this study was primarily focused on preventing the user from abandoning the system at the very first phase because of unexpected difficulties or uncertainties. Similarly, the e-learning platform “back office” functionalities have not been taken into consideration in this study.

Fourth: the SUMI questionnaire has given good results and has proved to be a tool to quickly inspect subjective usability perception, but many users have had uncertainties when answering some items that did not seem be not pertinent. The median score values are comparable with the ones reported in other studies [12].

Finally: Comments, even by initially very skeptic users, have pointed out a positive attitude to use the e-learning system.

In conclusion, investing in improvements of usability has proved to be useful, even when not recommended as mandatory. In the present paper we have described the process we have followed to overcome one kind of obstacle for the use of e-learning systems, although this one is probably the most critical. The e-learning system is intended for a very wide variety of people, not known in advance, where the first impression do make the difference between “using or not using” the e-learning tool. Only data collected from real users will allow a more exhaustive evaluation, nevertheless positive expectations seem to be reasonable.

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References


