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Earnings in E-learning: Knowledge, CME credits or both? Hints from Analysis of Attendance Dynamics and Users' Behaviour

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Abstract

Many papers report and convey positive opinion about the use of e-learning in the healthcare sector. The issue is how to exploit at best such a powerful instrument. Starting from data regarding the usage of a CME e-learning course, attendance dynamics and users' behaviour have been inspected with the aim of getting some hints about how to improve the development and the delivery of e-learning courses for CME, and to promote knowledge acquisition at best. The different paths followed by 7811 users have been modeled, from enrolment to conclusion/drop-out, then the behaviour in terms of effort, elapsed time, achieved result have been analyzed. The obtained results point out: good acceptance (retention rate 83%) of a not basic educational model and effectiveness (success rate 79%). At the same time the inspection of behaviour has shown that there is a good margin of possible improvement in terms of knowledge acquisition. Conclusions provide a list of issues to keep in mind during system development, in order to provide CME e-learning meeting both credit and knowledge acquisition goals.

Keywords:

E-learning, CME, Attendance, Users behaviour.

Introduction

Many papers report and convey positive opinion about the use of e-learning in the healthcare sector. Quoting one for all [1], "E-learning represents a quantum leap forward in the education of healthcare staff. It has the potential to...provide a flexible, adaptable and highly accessible route to learning, which delivers a myriad of benefits for staff, hospital management and ultimately the patient". The issue is how to exploit such a powerful instrument at best, to let potential benefits become everyday reality.

As regards Italy, under-graduate distance education has gained ground, but e-learning for CME has been moving only short steps for years, despite of the common positive opinion of the potential users. This fact is due to two main reasons. First, problems related to the accreditation of e-learning courses within the not problem-proof co-existence of national and regional CME credit systems; for this reason the offer is limited. Second, the lack of consensus about the term "e-learning", often confused with simple delivery of documents and questions through the internet. This basic modality limits the evaluation of the learning experience and probably also the effectiveness of the intervention.

Within an experimental project funded by the Italian Ministry of Health, an e-learning system for CME has been developed for free of charge usage on the internet (http://fad.cbim.it). As described in the following section, the educational model proposed to users is not the basic one already experimented by Italian healthcare professionals.

International literature is quite rich of studies inspecting the attitude of users, and nurses in particular, to e-learning [2], but, as far as in our knowledge, lacks papers dealing with the behaviour of students attending e-learning CME courses and the relative dynamics. This information could be useful when starting developing a new system, in order to take advantage from previous experiences, and to limit, if not avoid, already faced problems and mistakes.

Thanks to the availability of a quite large amount of data regarding the usage of e-learning courses for Italian health professionals, an heuristic study of what works, what goes wrong, what can be improved has been carried out. Among all the available courses, a course about patients' handling (PHC) in hospital environment has been considered for the study presented here. The choice was motivated by a quite large number of enrolments and the fact that it addresses a large population of users (nurses and physiotherapists) for which the course is accredited by the CME system.

Aim of the present paper is hence to understand the dynamics underlying the usage of the system, and in particular:

- Users' flow from enrollment to conclusion/drop-out
- Students' behaviour and preferences in attending the course and achieving the final goal

in order to get some hints to improve the development and delivery of e-learning courses for CME, to verify the applicability of the educational model chosen, and find the best way to promote knowledge acquisition.

Materials and Methods

The patient handling course

PHC deals with: basic knowledge relative to musculoskeletal disorders, specifically linked to biomechanical load during lifting actions and flexed postures; Risk factors and the characteristics of spaces, patients, devices, furniture, and work organization which affect the way the operator works, and the ergonomics of movements; Proper use of different types of devices (ceiling and active lifter, low friction and assistive devices, bariatric solutions, ...) which concur to risk reduction and patient safety enhancement.

The educational model is based on:

- An initial test (IT) (one attempt allowed), mandatory to access the learning modules;
- Self-learning structured modules for free navigation (including PDF printable versions);
- Case-study exercises/test (CST) (4 attempts allowed, minimum score to pass the test: 75%), particularly effective [3] in order to reinforce the learning process;
- A final test (FT) (4 attempts allowed, minimum score to pass the test: 75%) for the evaluation of the results of the learning process in comparison with the IT;
- A satisfaction questionnaire that evaluates the subjective perception of the users.

PHC is expected to be concluded in five hours, tests included. To stand the course both CST and FT must be positively concluded.

Evaluation methods

All the enrollments to PHC in the span of time of 20 months have been retrieved and exported from Moodle database, and have been catalogued in terms of:

- Characteristics of the student: age, sex, profession
- Characteristics of the event: date of enrollment, IT result, CST result and number of attempts, FT result and number of attempts, date of course conclusion, final outcome (passed /not passed).

To identify and describe users' flow from enrollment to conclusion/drop-out, a Markov-like model has been used, taking into consideration time variance, due to the existence of the drop-out event.

Drop-out was defined according to the rule "course not concluded .AND. (end of the inspecting period – date of enrollment) > 30 days". This choice was necessary to avoid declaring as drop-out those students that have enrolled in the month just preceding the final date of inspection, and that maybe could have concluded the course subsequently.

To analyze users' behaviour and preferences regarding the way of achieving the goal, number of attempts to pass the tests and time used to conclude the course have been calculated. At this last purpose, the difference between date of conclusion and date of enrollment has been used; it refers to elapsed time, not to continuous learning activity.

Results

Users' flow model

Figure 1 provides a schema of the paths followed by users to conclude the course or abandon it. Basic actions have been used to describe the steps of the process such as: enrollment, IT execution, first and second test execution with results. In the graph circles represent actions and squares represent reached conditions (success, failure, drop-out). Branches represent the flow extent, expressed as number of users.

During the observed period, 7811 users have enrolled in PHC, but 5.2% of them dropped-out (*immediate drop out*) even before having performed the initial test (IT).

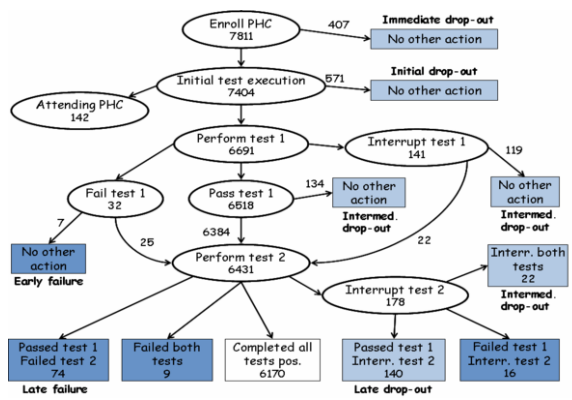

Figure 1 - Schema of the paths followed by the users

7404 users have regularly executed the IT, and hence they have got the possibility to view the contents and potentially attend PHC in an active way. This sample (mean age 40.6, range 21 – 58) is composed mainly by female (5513/ 7404, 74.5%). As regards professions, nurses (N) represent 80.0% (5922/7404), therapists (T) 13.6% (1008/7404), and the remaining 6.4% (474/7404) belong to other healthcare professions for which the course is not accredited.

At the time of the present analysis, 142 users were still attending PHC, so they were excluded. A second quite large drop-out event (*initial drop-out*, 571/7404, 7.71%) occurred before performing at least CST or FT. The sample of people actively involved into PHC attendance is hence composed by 6691 users, representing 85.66% (6691/7811) of the enrollments.

In the graph, "test 1" indicates one of the two tests without distinction between CST and FT. In case a student had performed two tests, priority has been given to the one success-

fully finished, or, in case of a combination failure/interruption, to the failed test.

The very great majority of students has stood one test (6518/6691, 97.41%). Only 1.8% has interrupted the test and has not undertaken any other action, reaching the condition of *intermediate drop-out*. The same condition is reached by those students (134/6691, 2%) who stopped attending, even in presence of a positive result, and by the users who have interrupted both the tests (22).

Considering the few cases of first test failed, 7 out of those 32 students abandoned the course definitively, reaching the condition of *early failure,* while some others (25) decided to perform the second test, even if they knew that they would have never been considered as eligible to get any credits.

The second test was performed by 6431 students representing 86.9% (6431/7404) of the population that actively attended the course and 82.33% of total enrollments. The group is composed both by many of those users who have stood the first test, and by some students who have already failed or interrupted the first test. Combining the results of both tests, the graph shows the ending points of the different paths. Success condition is reached by 6170 users representing 92.2% (6170/6691) of the active users. The second largest group is the drop-out group: overall the drop-out rate is 17.8% of all the enrollments, and *intermediate + late drop-out* represents 6.2% of the active users. 106 students didn't pass the tests of the course, but 70% of them belong to the status *late failure* since they have positively concluded one test. Table 1 represents the summary of the final conditions.

Drop-out

Looking at the users that have dropped-out, few issues can be analyzed but hypothesis are possible or reasonable. For *Immediate drop-out*, belonging to a not accredited professional category is not relevant. Only 51 out of 407 users could have dropped out for this reason. A further hypothesis is that the educational model with a mandatory IT, double typology of tests, and a limited number of attempts is not well accepted by users. In this case the educational model is not appreciated by a small number of people (4.7% of all the enrollments).

Initial drop-out: Out of the 571 users, only 42 belong to professions different from nurse or physiotherapist, similarly to what happens for immediate drop-out. Maybe the message sent to the user as evaluation of IT result has discouraged the student to go on. For IT results lower than 70, the message is "you do need to attend PHC …". This was the message received by 434 out of the 571 users that have abandoned just after the IT. But, as it will be pointed out in the next session, the same message was sent to at least other 1443 students, who have anyway concluded the course achieving positive results. Personal characteristics play anyway an important role in people behaviour.

Students' behaviour

The very great majority of the courses have been concluded (6276/7404, 84.8 %).

For positively concluded and failed courses, Table 2 shows a summary of students' characteristics and learning process indicators. Outcome in terms of knowledge acquisition can be evaluated through the mean values of test results. In particular Table 2 reports data grouped according to the different professions. Group "other" represents the users who have no right to get credits. The number of days used to conclude the course is calculated as difference between date of conclusion and day of enrollment, and if they occur in the same date, 0.5 day has been considered.

Table 1 – Summary of the final conditions

	% out of 7811 enrolments
Immediate drop-out	5.2
Initial drop-out	7.3
Intermediate drop-out	3.5
Late drop-out	1.8
Success	79.0
Failure	1.4
Total	98.2
Attendance still going on	1.8

The mean value of FT results for successful students points out that there has been a pretty good gain in terms of acquired knowledge. Similar comment can be done for students who didn't pass the course. CST and FT success rate are 23% and 51%, hence case-based tests seem to be more difficult. Anyway, the number of people (82) who failed CST is very small, in comparison with the number of successful students.

Table 2 - Summary of students characteristics and learning process indicators

		#	Mean elapsed time	Median elapsed time	Mean IT result	CST mean result (%)	CST mean # attempts	FT mean result (%)	FT mean # attempts
Course passed	N	4901	7.3	1	62.74	94.16	1.42	92.7	1.24
	T	897	10.3	2	71.39	93.8	1.48	93.7	1.21
	Other	372	9.19	0.5	65.71	93.10	1.53	93.5	1.29
Course not passed	N	82	8.15	1	48.39	70.6	3.7	68.10	2.54
	T	14	9.04	1	49.0	77.36	3.4	55.15	2.7
	Other	10	2.6	0.5	46.39	65.00	4.0	65.40	2.9

Table 3 - Percentages of users that have concluded PHC for number of performed attempts and elapsed times (days). Users are divided into 3 groups: success with high IT (SH), success with low IT (SL) and failure (F).

days	S H	S L	F	S H	S L	F	S H	S L	F	S H	S L	F	S H	S L	F	S H	S L	F	S H	S L	F	S H	S L	F
>3	16.3	11.9		7 . 4	5 . 3		4 . 2	3 . 6	3 . 8	2 . 5	2 . 1	11.3	0 . 9	1 . 7	8 . 5	0 . 2	0 . 7	6 . 6	0 . 3	0 . 3	8 . 5	31.8	25.7	36.7
3	2 . 4	1 . 7		1 . 2	0 . 6		0 . 3	0 . 6	0 . 0	0 . 3	0 . 3	2 . 8	0 . 1	0 . 3	0 . 0	0 . 0	0 . 0	0 . 0	0 . 0	0.0*	0 . 0	4 . 3	3 . 5	2 . 8
2	3 . 8	3 . 3		1 . 2	1 . 5		0 . 8	0 . 8	0 . 0	0 . 3	0 . 3	0 . 9	0 . 2	0 . 3	0 . 9	0.0*	0.0*	0 . 9	0 . 0	0 . 1	0 . 0	6 . 4	6 . 4	2 . 8
1	7 . 4	7 . 0		2 . 7	1 . 9		1 . 1	1 . 1	0 . 9	0 . 4	0 . 7	4 . 7	0 . 5	0 . 8	3 . 8	0.0*	0.0*	1 . 9	0.0*	0 . 3	3 . 8	12.2	11.8	15.1
0	33.6	42.0		7	5 . 5		2 . 8	2 . 8	1 . 9	1 . 4	0 . 9	17.0	0 . 5	1 . 0	5 . 7	0 . 1	0 . 3	6 . 5	0 . 3	0.0*	9 . 4	45.7	52.6	40.6
	2 attempts			3 attempts			4 attempts			5 attempts			6 attempts			7 attempts			8 attempts			total		

** values < 0.05.*

Behaviour in terms of elapsed time and attempts

The relationship among result of the course (passed, failed), effort (as number of attempts) and elapsed time has been analyzed. In order to understand the influence of pre-course knowledge on users' behaviour, the sample of successful students has been split according to the result of the IT (<50, >=50).

Table 3 shows the distribution of cases along the dimensions *number of attempts* and *elapsed time* for the three groups: success with low (SL) IT (1443), success with high (SH) IT (4727), failure (F) (106). A large number (2194) of successful students have completed the study of the learning objects and have performed both the tests in just one attempt each, on the same day of enrolment.

SL group, expected to need more time and effort to positively conclude the course, has the greatest level of task orientation: 42% performed 2 attempts with 0 day of elapsed time. From this point of view SH and SL show a statistically significantly different behaviour.

As regards F group, 41 out of 106 students have believed their learning activity sufficient, and have then used all the chances they had to stand tests in an elapsed time of 0 day. Among these students, 12 belong to the late failure category, having stood 1 test and missed the opportunity to pass the course.

Time flexibility offered by e-learning and the multiplicity of available attempts should have induced F users to study again in order to achieve the goal of standing the course. These opportunities have not been used by those people who could have needed them more.

Independently from the number of attempts and from the final result, most of users finalizes their activity not later than the day after enrolment: 57.9%, 64.4% and 55.7% respectively for SH, SL, F.

About 30% of the students in all groups have an elapsed time greater than 3 days. Most of them have probably started attending, then interrupted to restart and perform the tests only after a certain span of time. The range of the elapsed times is very wide (0-267 days), as the differences between median and mean duration in Table 2 show. The minimum mean value is 7. Elapsed time of 7 days has been hence chosen to distinguish between students who have been attending PHC for a quite long time, from those who have initially enrolled but have attended the course only "lately". Using this distinction, in Table 3 the total percentage (36.7%) of students that failed with an elapsed time greater than 3 can be split into long lasting attendance (9.3%) and late attendance (27.4%). For successful students, the percentage of long lasting attendance is higher. Considering for example in 2 attempts completion for SH and SL globally considered, 247 students out of 942 (26.2 %) behaved according to the definition of long lasting attendance.

It can be hence concluded that, in any case, there is a common attitude to finalize the course in a short span of time.

Behaviour in terms of achieved results

For the successful users, the previously reported results raise a question: have the users, who passed the course with few attempts, achieved the best possible results?

Taking into account the final score of the course, that is the sum of the best results of CST and FT (range 150 – 200), Figure 2 shows the mean final score values versus the number of attempts still available. Since the number of allowed attempts is 8, "6 remaining attempts", for example, means that the user has stopped performing both tests after the first attempt, having reached a sufficient result to pass the course. For each value of remaining attempts, the mean final score values are quite far from the maximum value (200). This fact points out that, once reached the condition for getting credits, the majority of users didn't exploit the possibility offered by the system to understand where they have done mistakes and hence to go back to the modules and further improve their knowledge.

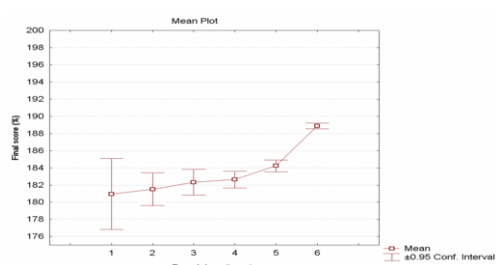

Figure 2 - mean final scores values versus the number of attempts still available

Discussion and conclusions

Attendance dynamic and students' behaviour, when applied to e-learning courses, should approach various processes related to the learning activity. In the present study only the basic actions have been inspected such as tests' completion, without taking into account, for example, how students have exploited the resources in terms of contents, and if they have preferred navigation to the usage of the printable version of the course. This issue will be addressed in a next study.

As regards the dynamics followed by the users, the reported results show that PHC has been attended, step by step, by a large number of users, until they have reached their goal.

For distance learning, literature [4] reports high drop-out rate. Moreover attrition plus limited informatics literacy and attitude are often mentioned as the most frequent causes for drop-out. In the present study retention rate is pretty high (83%), and probably it could have been even higher in case PHC had not been free of charge. The initial choice of developing giving priority to technological simplicity and usability [5] of the e-learning system has probably paid out. Some other causes for drop out have been analyzed [6].

The large number of attendees and the high success rate support the applicability and acceptability of the educational model with the constraints that have been used. Inducing a responsible learning approach, it should be more effective than the one with no limit to the number of attempts, commonly used in Italy.

Not only nurses and physiotherapists have attended the course, but also 474 health professionals for whom PHC doesn't provide credits. 80.6% of these users have completed the course. This fact points out that CME e-learning courses are appreciated and requested, but also that maybe people don't read carefully the instructions when on the internet. This last same hint comes also from the messages sent to the tutor. For the behaviour parameters that have been analyzed, there are no comparable results in the literature, as far as in our knowledge. The attitude to finalize the course in a short span of time is, in some way, in contrast with the valuable manage-your-time approach typical of e-learning. In particular, since PHC was expected to take up around five hours overall, the student, who have finalized it with elapsed time of 0 days, must have done it fairly quickly. The result of passing the course is often achieved, but not with the best possible outcome in term of knowledge acquisition. A way to promote and incentive better quality of results thanks to the flexibility of e-learning should be put in practice.

For this last purpose, but not only, the presence of a figure with role of mentor could be very useful. When dealing with e-learning systems available on the internet, the number of enrolments can be very large and mentoring very resource consuming. A sort of automatic mail delivery system with scheduled controls and planned remainder and encouragement messages could represent a good feasible solution.

We are aware that conclusions are based on heuristics and direct experience only. Anyway, we dare to give a list of advices to keep in mind, in order to help developing e-learning systems that could be useful tools to provide knowledge improvement and not only machines to collect CME credits.

- Robustness of the educational model doesn't imply reduced attendance
- Give priority to technological simplicity and usability
- Feedback messages should be designed considering different possible reactions
- State clearly and in a very visible way the rules and basic information. Redundancy is boring, but disappointment is even worse
- Develop courses that take up a limited numbers of hours (five hours are probably too much)
- Look for incentives to achieve the best results in term of knowledge acquisition, to prevent to go just for the credits
- Plan an affordable system to provide mentoring.

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