Evaluating quality of e-learning courses: Investigating on survey development

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Abstract: - This paper describes first results in the field of the development of an efficient survey to evaluate quality of e-learning activities. The research intends to evaluate not only quality in use but also quality in learning. It represents an attempt to produce and organize survey questions that allow evaluating not only the easiness in managing a learning product but also its usefulness and learnability. The evaluation instrument enables to monitor the quality of the interface, the quality of the contents and the capability to transfer new knowledge. First results show its efficiency in investigating the organization of e-learning processes.

Key-Words: e-learning, quality evaluation, survey, usability, learnability.

1 Introduction

Information and communication technologies are transforming the process of learning and can also improve learning capabilities. Institutions, industries and universities are leading business to search for better and more effective ways to manage the growing requirements for learning solutions: e-learning is becoming one of the most popular solutions to meet this need. In e-learning the emphasis is often focused on technical aspects, whereas the relevance of learning products for the actual process of learning is not enough considered. But the most important aspect of a learning product is its aptitude to provide knowledge by stimulating an in dept study, further researches and close investigations. The added value of an e-learning activity is in the learning itself.

How technology can yield an added value? What can be done with technology that could not be done without it? These are the main questions that need an answer in order to be able to engineer and develop more effective learning products. The educational software production needs to be focused on the process of learning and on the enrichment of the educational process. Handouts, animations, lecture slides and videos, at the end, if considered separately, do not add nothing to the actual process of learning, they represent only a different form of content distribution. Indeed, if effectively combined and integrated, they can become a good way to vehicle effective learning.

2 Good Engineering Principles for e-Learning Products

The principles presented in the following lines serve as guidelines to engineer, implement and re-engineer educational software, they represent a goal to strive towards [1]. At least five principles need to be considered while developing learning products:

a) content based on fundamental ideas;
b) incorporation of different cognitive levels;
c) high degree of interaction;
d) feedback;
e) visualization and fit for use.

a) The production of multimedia learning software need to be centered on fundamental concepts. Bruner's concept of "fundamental idea" [2], better qualified by Schwill [3] as a schema for thinking, acting describing or explaining, that is applicable in different areas, that may be demonstrated and taught on every intellectual level, that can be clearly observed in the historical development and will be relevant in the longer term, and that are related to everyday language and thinking, need to be considered.
b) Educational software offers a broad range of task at different cognitive levels. Bloom [4] developed the taxonomy with six cognitive levels, arranged in an increasing complexity order: knowledge, comprehension, application, analysis, synthesis, evaluation. Good educational software would emphasize the higher cognitive levels: analysis, synthesis and evaluation.

c) A high degree of interaction defined by Laurel [5] as involvement in the computer representations of the contents would characterize educational software. Schulmeister [6] suggests six increasing human-computer level of interaction: no interaction at all, but only display of information; navigation through the representation of information; multiple representation of the content; possibility of modifying the parameters of the representation; possibility of modifying the content; possibility of creating and manipulating objects and observe system reaction. But Berg [7] observes that highly interactive software is almost not existent in higher education.
d) The software feedback can assist the learning process. Roughly there could be defined two levels of feedback: implicit feedback and explicit feedback. In implicit feedback the learner must interpret the output the software produces while he interacts with it. In explicit feedback an automated system suggests comments and right choices, points to learner mistakes and correct answers, provide support and explanations.
e) When people interact with a software product, they need to familiarize with the software interface, but since in learning products the software interface is not the subject itself, it should be as self explanatory as possible. There are several guidelines to design multimedia objects [8] and to use web contents [9], but in practice, in many cases, such guidelines are not effectively applied and they are reduced to the excessive use of animations. Guzdial and Soloway [10] argued that educational software needs to correspond to multimedia environments and to student everyday use of computer. Moreover according Varisco [11, 12] a meaningful learning need to be: Constructive; Active; Intentional; Collaborative; Conversational; Contextual; Thoughtful. The final objective of a learning object is to realize three fundamental learning goals: to form learners responsible of their learning; promote real and meaningful learning environments and contexts; create stimulating situations and learning dynamics. Finally according J. McTighe and G. Wiggins [13] the purpose of question in tests is to start and motivate the learning process; drive learning attention; steer learners giving them hints for researches and reflections; point out the main ideas and the most important concepts.

3 Usability problems in e-learning

In spite of all efforts, in the last years e-learning has experienced slow user growth involvement and high dropout rates in many organizations: users become easily frustrated or unenthusiastic about the material and do not complete learning activities [14]. Available usability tests do not provide designers with suggestions to design courses that capture users' interest. Classical usability tests are already part of software and product design.

Nielsen [9] brought the concept of usability into the web, making web pages simple to navigate and intuitively organized. In e-learning these principles need to be specialized to encompass a few more concepts. A learning web page is usable if it is useful. A learning product must not only have an easy to use interface, but it should also serve a purpose. Learnability of the learning product should also be considered. Norman [15] defined Learnability as the ease and the seed with which users can figure out how to use a product without training or manuals. In the world of e-learning this definition need to be better qualified to include the ability of learners to effectively learn and retain skills and knowledge. The level of learnability of a course should be associated with the strengths and weakness of the instructional design. The e-learning products, engineered with usefulness and learnability in mind, have intrinsic high instructional value [16]. Learners more probably will use them. Elements missing in e-learning, such as instructor presence and actual physical meeting environments can be easily encompassed with learner involvement. E-learning specific usability testing activities need to be carried on to allow better understanding of learners' needing.

Achieving usability into the design of e-learning products includes: utilizing knowledge gained during the production phases; employing interface design principles; using instructional design principles. These principles would not be considered in isolation but viewed through the lens of: feedback; curiosity; relevance; control; challenge; and contextualization.

Usability evaluation need also to include post-course assessments, surveys and interviews, to gain a deeper understanding of the impact the training product has on the learners. The combination of all these elements helps measure whether or not the e-learning program meets the prefixed goals. Such activities enable also continuous administration of courses by successive refining.

4 Learnability of e-learning products

Learnability can be defined as the capacity of an e-learning system to support or activate a specific cognitive process [17].

One of the most important aspects to consider while building a didactic path is the management of the mnemonic capability. The modal model [18] is the most widespread model to describe the way in which brain operates. To make learnable a didactic object means allow learners use his own memorization capabilities for didactic aspects, while lightening his mnemonic charge from accidents such as interface structures or operational functionalities.

The expectancy grammar represents the store of knowledge that everybody develops with experience and study. According to Oller [19] it represents the real psychologically interiorized grammar. People speaking or writing plan what to say or write in the next future and control the result, to see if it corresponds with the desired or expected results.

If the speaker intention corresponds with the hearer assumptions, communication is efficient and effective; otherwise it fails. The same principles can be applied in e-learning [20]: learners, beside expectation based on their historic-cultural background, develop new expectations during learning. Increasing learnability means to promote the identification of expectations and to facilitate matching operations between past knowledge and new information: it means to enhance learners' baggage with new elements, structures and contents and to anticipate their expectations.

5 Overview of existing surveys

In past years some surveys have been proposed to evaluate usability of e-learning product. In many cases, they consider some aspects in spite of others. The most important are the COLLES, the CLES and the ATTLS.

5.1 COLLES – Constructivist On-Line Learning Environment Survey

It has been designed to monitor the extent of the interactive capacity of e-learning products to engage students in dynamic learning practices and to show how web teaching enriches distance students' ways of knowing; it generates a measure of students' perception of both their preferred and actual on-line classroom environments. The COLLES contains 24 statements grouped in 6 scales [21], each of which address a key question about the quality of the on-line learning:

- Relevance: How relevant is on-line learning to students' professional practices?
- Reflection: Does on-line learning stimulate students' critical reflective thinking?
- Interactivity: To what extent do students engage on-line in rich educative dialogue?
- Tutor Support: How well do tutor enable students to participate in on-line learning?
- Peer Support: Is sensitive and encouraging the support provided by fellow students?
- Interpretation: Do students and tutors make good sense of each other's communications?

There are three forms of the COLLES: a preferred form, an actual form and a combined preferred and actual form. It contains a five-point Likert-type response scale, with scores ranging from 1 to 5. The survey is based on social constructivism that considers the learner as an active conceptual actor within a socially interactive leaning environment. Social constructivism is considered as a way of knowing in which the learner collaborate reflectively to co-construct new understandings, especially in the context of mutual inquiry grounded in their personal experience.

The development of students' communicative competence, that is to say the ability to engage in open and critical discourse with both teacher and peer is essential in this model. The discussion need to be oriented to constructing reciprocal understanding and a critical attitude towards underlying assumptions.

5.2 CLES – Constructivist Learning Environment Survey

Developed by Peter C. Taylor and Barry J. Fraser at Curtin University of Technology, the CLES survey [22] was intended specifically for science classrooms, and includes five scales: "Learning about the world", "Learning about science", "Learning to speak out", "Learning to learn" and "Learning to communicate". The survey is available in two versions, actual and preferred. Each version consists of 25 questions with 5 possible answers each one: almost never, seldom, sometimes, often, almost always.

5.3 ATTLS – Attitudes Towards Thinking and Learning Survey

The theory of 'way of knowing' originally from the field of gender research [23] provides a survey tool to examine the quality of discourse within a collaborative environment. The ATTLS [24] is an instrument to measure the extent to which a person is a 'Connected Knower' or a 'Separate Knower'. A

Connected Knower tends to find learning more enjoyable, congenial and more willing, and tends to build on ideas of others. A Separate Knower tends to take a more critical and argumentative stance to learning.

6 The new proposed survey

The quality of educational software is the product of many factors; therefore there are different quality aspects to consider. In this paper only a selected number of quality criteria with high level of abstraction, investigating the most relevant aspects of e-learning, are considered.

The proposed survey consists of three main sections; the first section consider the quality in use, the second section considers the learnability of contents, and the third and final section collects information about the involvement capability of the didactic material.

The first section, about quality in use, considers various factors:

- The simplicity of the graphic style;
- The distinction of interface elements;
- The operation of navigation tools;
- The availability of multimedia elements;
- The coherence of page contents;
- The accuracy of multimedia production;
- The overall easiness in use of the didactic module.

The second section, concerning with content learnability, investigates:

- The clarity of the didactic objectives;
- The clearness and correctness of the content;
- The congruity of lexicon;
- The adequacy of contents;
- The applicability to real situations;
- The coherence, consequence and clarity of explanations;
- The presence and easy identification of evaluation instruments;
- The stimulus to return back to visited contents;
- The expression of a comprehension level measure;
- The individualization of not well understood concepts;

The third section contains final questions to investigate the level of involvement of the learner in the didactic module; it investigates if:

- The entire didactic module spurs learners on further researches;
- The availability and use of reference material results useful;
- There are sufficient materials included in the didactic module or if it results better to use external products;
- The entire set of resources and documents allows a satisfactory comprehension of the topic.

At the end, in the last question of the survey, the learner is invited to indicate if there is something missing in the learning product, and where to include the missing arguments in the presentation of the electronic lesson.

7 First survey results

First results have been obtained by utilizing one of the learning modules (*Figure 1*) - didactic module on Introduction to Discrete Systems - developed, published and imported in the Oracle iLearning LMS during the activities of the PROTEO project carried on at the University of Bari with the support of the Italian Government and of the European Union [25, 26, 27]. It constitutes an enhancement of former activities and a starting point for further developments [28, 29, 30].

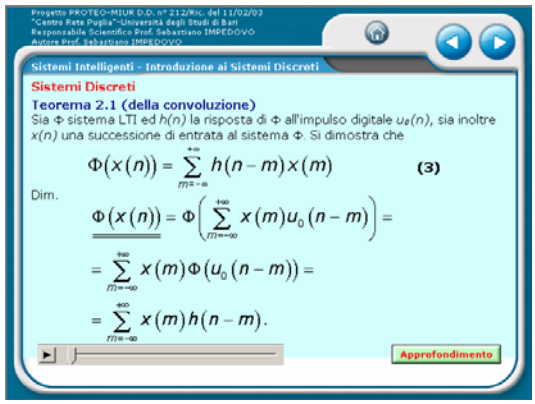

Figure 1: *The Convolution Theorem*

By considering the didactic module under examination, a fist test involved 20 university students that used the product in e-learning.

Analyzing the results of the section on quality in use it results that the graphic laying and the choice of colors are good and that there is no distraction element; the characters have a discrete readability and there is an enough good coherence in page presentation. The elements of pages result easily distinguishable and the correctly operating navigation tools enable a sequential navigation among pages. Multimedia elements are included in almost all pages and result correctly operating. Information in pages and associated multimedia elements results coherent, but not always audio files are of good quality. On the whole, the didactic module results to have a good usability level, with a

good organization. The written parts in the presentation pages and the comments result to have a more than discrete quality, and graphics and images are more than good; animations and audios are between discrete and good.

By considering the learnability of the didactic module it results that all students classify the subject as a scientific topic with an enough high level of difficulty. Not all learners consider clearly expressed the objectives of the learning product, but all of them agree to say that the final goal of the product is to introduce to discrete systems, and consider that the attainment level of the objectives is more than discrete. The explanation results syntactically and semantically correct, without mistakes or ambiguities; the lexicon is completely faithful to the subject, and new terms are always explained before their use.

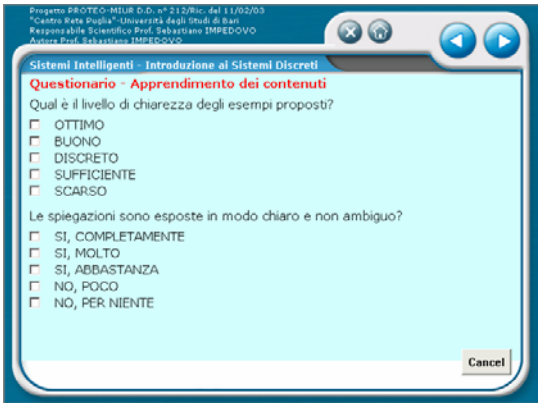

Figure 2: *Presentation and example clarity*

Te content adds new knowledge to learners and subject complexity is made enough simple; the comprehension level is discrete and the presentation forces learners to reflect a lot. The concepts are explained by mean of examples, definitions, theorems and demonstrations (*Figure 2*). Situations are applicable to real situations and are explained with enough good examples. The explanation technique is coherent in the entire product, but in some cases the learner needs to return on already visited pages to reconsider former understanding.

Evaluation tests result available for the specific learning module and easily selectable. The questions, with relative answers, are clear and not ambiguous also if they require some time to be understood. In some cases the tests forces learners to return to the didactic material to deepen the presented concepts. The tests cover all the principal topics of the learning module and they offer a measure of the subject comprehension. The level of understanding achieved by learners is expressed as the sum of available points associated to each question and as the percentage of correctness of the answered questions. If feedback is available, it is easily possible to verify the correctness of answers; otherwise, it is necessary to reflect on the values of answers by reconsidering the didactic pages.

By considering questions in the third section, in some cases learners tries further researchers and considers useful the availability of reference materials. The entire set of available resources and documents allow an enough good comprehension of the subject. In conclusion the survey points out that some explanation result difficult to understand and that they need to be presented with a greater wealth of details.

8 Conclusion

By mean of the proposed survey, usability can effectively be investigated in its various aspects, as the effectiveness, efficiency and satisfaction with which users can achieve tasks in a particular learning environment. To achieve high usability means that the product illustrates the content in a way that is easy to learn and remember, visually pleasing and fun to use, quick to recover and efficient in use. In this way usability issue include interface and navigation design, content layout, accessibility and memorization properties. In this contest learnability refers to the qualities of the product or process that help make it easy to learn.

The survey allows evaluating not only the quality in use of a learning module but also its usefulness, learnability and learner involvement. It enables to monitor the quality of the interface, the quality of contents and the capability to provide new knowledge and cognitions. The main properties of a learning product are all investigated and sound out. The results point out the quality of the multimedia product to provide learning, the real needing of learners and possible enhancements to the actual implementation of the virtual lessons.

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