Communicability for Virtual Learning: Evaluation

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Abstract. An assessment is made of the work of design from the perspective of communicability and usability in multimedia aimed at E-learning, mainly through the off-line interactive systems (commercials) and on-line (open software). The method used is accompanied by a series of heuristic results along time to stress the validity or not of some of the design components. Besides, a novel strategy of organizing the textual content is presented for teenagers and the young: the truncated inverted pyramid. Finally, those quality attributes are mentioned that are related to the dynamic and static means, at the moment of heuristically assessing the communicability of a hypermedia system which has as its main goal college education.

Keywords: Virtual Learning, Evaluation, Content, User-Centered Design, Open Software.

1 Introduction

Traditionally some professors have used the Internet, whether it has been within the university environment or out of it, in order to insert the programme of topics, lessons, examination dates, sample exam questions, interesting news, etc. However, E-learning is a superior stage according to modern pedagogical theories because it does not only consist of elaborating education material but also taking part actively in the teaching process [1], [2]. This can generate not only bi-directional student-professor communication, but a virtual community among students to share experiences and even allow some of them become tutors or professors of their peers [3]. Moodle (Modular Object-Oriented Dynamic Learning Environment) is a Course Management System (CMS) also known as a Virtual Learning Environment (VLE). Moodle has the great advantage of being able to be used with different complexity levels with a very soft progressive curve of learning with regard to the obtained results. That is, it is the professor who can determine the speed of the learning process, in relation to the motivation detected as the students progress and assimilate the content. Consequently, we are now faced with one of the main axes for the success of e-learning, that is to say, that the learning curve is flexible with regard to

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professors and students. When the instruments are presented in a rigid way towards the teachers, it will be difficult to implement e-learning in the time planned. As is the case with other platforms aimed at e-learning, in almost all the centres where Moodle has been used,there has been a need to create seminars, demonstrations, interchange of experiences, etc. for the use of the platform, training courses for the staff who will use the Moodle, assistance in the design of the courses (even in the transformation of the traditional material that normally use the professors for their schoolroom teaching), and activation of a help desk. It is very important that the help desk be located inside the university and that it is not an outsourced activity [4]. There is an endless series of negative experiences in this sense inside the software context and computers because the user needs access to a person who can explain or solve the problem. In Northern Italy, for instance, the assistance is only available by phone in the commercial world, and involves having to wait until an external technician arrives at the premises where the problem has originated. The costs are high because they include the commuting to the place where the problem is to be found. Outsourcing is avoided as an ideal solution in the software [4]. The current research work is structured in the following way: a brief state of the art of the software used in E-learning college education currently. Later on, the advantages of organizing textual information under the form of truncated inverted pyramid are considered. Then the diachronic results obtained from the heuristic assessment of the off-line multimedia systems off-line are compared, from the point of view of usability and those components of communicability are considered which have a great validity in the current on-line systems whose main purpose is teaching.

2 E-Learning and Open Software

University centres keep spending an important sum of their financial resources for the software licenses and the maintenance of the hardware of large servers. In contrast Moodle is a free web application that educators can use to create effective on-line learning sites. Today, the great universities are adopting Moodle for the realization of distance courses or support to presential lessons. Perhaps the main advantage lies in the fact that many applications with a cost equal to zero already exist. These have been evaluated and corrected in other university teaching centres. However, a series of problems to be solved persists before implementing those systems can happen. These problems are related to issues known as human factors of software engineering; guaranteeing an efficient use of the technological instruments from the point of view of usability; helping teachers in the design process, elaboration, assessment, implementation and management of a distance course; to use a design of interactive system that does not change according to the contents and types of studies made inside the academic curriculum; that is to say, that the interface used in a technical engineering in computers has to be similar for superior engineering and a master in design and credibility of the information in the web (for instance), inside the university teaching centre itself. Now we understand by design not only the distribution of the contents of dynamic and static means on the computer screen, that is to say, the presentation, not only navigation, the structure, panchronism, etc. In

order to satisfactorily overcome each one of these tasks it is necessary to count on an expert in communicability of interactive systems [5].

In e-learning, it is always necessary, from a financial point of view to use multimedia technologies within the reach of the greatest number of local users and in particular to the potential international users in the emerging areas. Therefore, it is incomprehensible and mistaken that a university under the teaching model "dual mode" plumps for iPod in E-learning, when the dean and over 75% of the professors do not have a digital culture. This entails resorting to outsourcing for the generation of teaching material and even the use of servers for academic management or ERP such as AS/400, creating teaching platforms in Lotus Domino, with very high costs in maintenance and management of software, hardware, professor training, content creation, etc. [6]. There are currently excellent gratis models [7] based integrally on Linux [8] in some Spanish regions as is the case in Extremadura. In this region, E-learning usually has a modest impact from the financial point of view (yearly computer budget) compared to some realities of "dual mode" universities in Lombardy (Bergamo city, for example).

These costs may also have an impact on the ondine laboratories dedicated to teaching which exist in the main universities of a country or a region. These laboratories have as their main goal the support of lessons outside of teaching hours to go deeper into subjects, small lessons tending to the stretching of the students, etc. In some cases these activities are under the CAI initials, –Computer Aided Instruction–. CAI may include activities referring not only to the students, but also to the professors. In the case of the professors it has as its essential goal the updating of the latest technological news and knowledge of the potential of the technologies for a qualitative, straight and fluent communication with the students [2], [9], [10].

3 Truncated Inverted Pyramid and Textual Contents On-Line

Historically, the textual contents and images are very important in educational multimedia systems [11], [12], [13]. The communicability proposed an efficient way of organizing the textual content in the hypermedia systems: the truncated-inverted-pyramid. In the inverted pyramid the most important things are at the beginning, while the least important ones are at the end [14]. But this organization of the text was not detected in the multimedia systems analysed, even if it is more important than the usability of the systems. The use of the inverted pyramid is useful to increase the speed of interaction between user and computer, above all in the case of encyclopaedias, where usually the text prevails over the images. In the textual static elements analysed broadly prevails the organization of the text as a normal pyramid, especially for dictionaries and encyclopaedias. The normal pyramid admits a division in five related areas:

1. Presentation or exposition of the theme (also called *lid*). In this area there is the content of the rest of the textual element (textual *sememe*).
2. Explanation of the principal idea. It is used to enlarge the presentation of the theme.

3. Sub-themes. It presents other aspects related to the principal idea.
4. Contextual information or *background*. It creates a context for the principal data of the theme presented.
5. More information about the presentation of the theme or *lid*. In this area there is a redundancy of information that consequently increases the space of storage of the information in the database. At the end, there are the least important data or a conclusion.

Areas two and three of the normal pyramid have been unified in the inverted pyramid. Therefore there are four related areas:

1. The lid is the principal area where there is a summary or a conclusion of the theme in no more than thirty words.
2. Explanation of the principal idea and development of the sub-themes.
3. Contextualization of the information.
4. Amplification of the lid.

The use of the inverted pyramid is a writing technique that simplifies the content, as the user has access to the textual element core from the beginning. This is the reason why it is better to organize information in the form of inverted pyramid in the hypermedia systems, particularly when the user has no experience in using computers, as for example the systems developed by UOC –Open University of Catalonian [14]. A graphical representation of the areas of a normal, inverted and inverted-truncated pyramid is shown in figure 1:

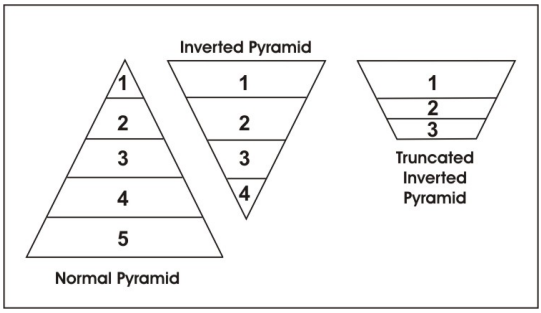

Fig. 1. Normal, inverted and inverted-truncad pyramids

In each one of the areas of the pyramid it is necessary to determine the extension of the paragraphs. From the experience carried on in the UOC [14], it is suggested that in the normal pyramid the number of the words in the first area should be between 15 and 20. For the inverted pyramid, the words should be about 30. While in the other areas the paragraphs should not be composed by more than 20 words. But usually this method is not followed in the multimedia systems as you can see in the following image representing the textual element of the definition of the "Hypermedia" – English language in the Wikipedia:

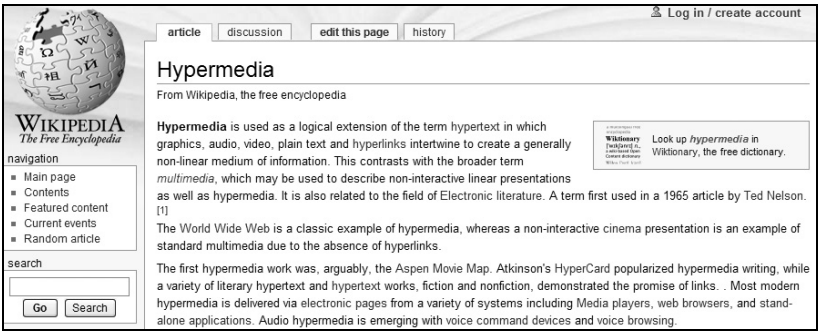

Fig. 2. Definition of the "Hypermedia" in the form of a normal pyramid with 70 words in the lid (first paragraph)

An analysis of the organization of the texts is important in order not to compromise the communicability of the multimedia system, as the understanding of the text can be difficult for the inexpert user, especially when the sentence of the text is composed of more than 20 words and there are only a few verbs (one or two). A good proportion is seven words for every verb [14]. The textual elements can be divided according to the type of pyramid presented for a detailed analysis of its content. Nevertheless, the analysis of the content should be different from the presentation or visualization of the content of the textual elements, as now the trend is to title or divide the paragraphs in order to fractionate the content of a large textual element, as for example the information concerning a country. To follow, there is an example where the textual information of the element Australia in the Zanichelli encyclopaedia [15] is divided in paragraphs with direct access. The text can be accessed directly from the titles of the paragraphs located in the inferior part of figure 3:

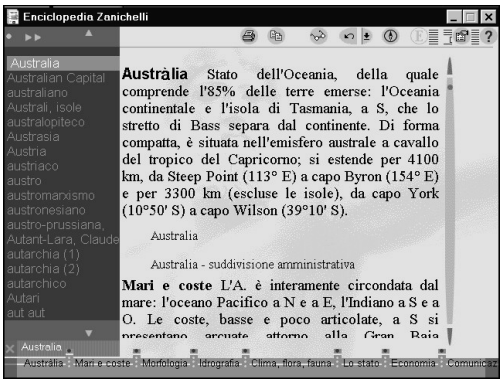

Fig. 3. Textual element divided and presented in paragraphs

Currently the so-called truncated pyramid is imposing itself in the texts of digital newspapers. The truncated pyramid structure is used when you have to combine the interest that comes from the facts with the need of giving a chronological order to the

account. It consists of the following elements: headline, starting paragraph, main body of the news (main data in decreasing order of interest and secondary data in a growing order of interest), and new essential data. In the truncated inverted pyramid the principles of the lid are maintained with the extension of the words that make up the paragraphs. However, it is necessary to cut down to 50% the explanation of the main ideas and the contextualization of information, which can be replaced by referential links.

These four areas of the inverted pyramid are ideal for adult and senior users of interactive systems, who have had previous experience in the off-line multimedia systems and are readers of the traditional books in paper support, including on-line. The young users feel boredom in the face of some of the components of the design of a hypertext structure, and consequently the interest towards the fruition of the content drops. Two examples may be: guided links with texts in the inverted pyramid format and of lineal structure, or rather textual referential links in the truncated pyramid format. Even in the case of using the truncated pyramid modality, many of them only read the lid or first paragraph. Therefore, it is necessary to keep in mind the use of the inverted or truncated pyramid, avoiding the use of the normal pyramid. In the first pyramids in it is necessary to sum up as far as possible the important information at the beginning, placing titles and subtitles that draw the attention of the potential users. Obviously, a senior or adult user whose purpose is research or seeing information on-line will be grateful in the end for new essential data or referential links.

4 Systematic Assessment

Systematic assessment is a set of abstract tasks defined by communicability specialists [5]. These tasks were carried out by a group of users who are experts in the computer environment in particular, in operating systems, or hypermedia systems. A systematic assessment in our case may consist in evaluating four categories of design such as presentation, content, navigation and panchronism. Obviously, the problems that were put to the users have required a previous analysis of the inconsistencies detected in the design [16], [17]. The analysis was the responsibility of a specialist in heuristic assessment in multimedia/hypermedia system. These inconsistencies or problems can refer to the guided tours [18]. A problem that can occur within them is when you can't have access to the nodes that make them up as it happens with the system. At first a guided tours is selected and the navigation through the nodes is made in a directional way. However, there is the possibility of going back to the visited node by choosing the historic listing option, if that component is present in the design category. The latter can only be known at the moment of navigating through the application. For instance, in a guided tours that refers to an artist's collection in a given period of his life, sometimes the paintings are presented with the node number that is being visited and the total of nodes that make up the collection. (node 7 out of a total of 45, for example). In some zone of the interface we can read 7/45. This helps the user in the orientation of the navigation. However, it is necessary that the information presented in the interface agrees with the structure of the nodes and links, that is to say, that you are really in node 7 of a collection of 45 nodes. Inside a set of nodes belonging to a group, joined by a common denominator from the

point of view of the content, for instance a historic era, a painting style, a study subject, etc. there are many nodes that have been used, that is to say, inserted in other groups but which do not adapt correctly to the new context. Finally, there can be dynamic means inside the guided links in which the advance or regression of each one of the nodes, can leave active these means: video, animation, music, etc. and prevent navigation, or there is no synchronism among them, thereby affecting the category of the panchronism. An expert in communicability will carry out the inspection of the multimedia system for the latter definition of a set of activities in a heuristic assessment with users. These activities are called abstract tasks. The communicability expert will consider the list of abstract tasks and the list of potential problems the user will find. With this information the assessor defines a series of actions or tasks to be developed by the user. These tasks that are enumerated and described next, may refer to an educational multimedia/hypermedia encyclopedia:

1. To find the geographical data of a country and the continent where it is to be found;
2. To locate guided links and make them navigate forwards and backwards;
3. To determine the borderline countries of that country;
4. Go to the screen of a region or province of that country to then be able to activate or de-activate the dynamic means, for example.

Before the realization of the described tasks, it was explained to the users which were the objectives to be reached and the kind of multimedia system that had to be analyzed. In the laboratory a computer system is available for the automatic recording of the time spent and of the answers of the users at the moment of carrying out the tasks. The tables listed the averages of the values for each tasks. Besides, the users' mistakes were indicated with an asterisk (*). If the user ignored the way to carry out the task, the situation was indicated with the letters (i). These letters mean that the user did not know how to do it. The data in the tables have made it possible to identify which were the critical points during the interaction person-computer. The user test has made it possible to check in this way the problems detected in the systematic inspection by the expert. Knowing the time spent and the total number of actions carried out by the users in each task, it can be seen how the problems found by the assessor in the systematic inspection that had previously made.

4.1 Communicability Diacronism and Heuristic Evaluation

With the purpose of comparing communicability diacronism and taking account of the evolution of design of the multimedia systems, the MEHEM methodology and the MECEM metrics [19] have been applied. Now the main results related to the application of the table of heuristic assessment are being presented, as described in [20], and the experiments carried out with users to verify the presented methodology. The results of the table are related to the universe of study which has enabled the elaboration of the suggested method. This randomly chosen universe of study is made up by 40 commercial CD-ROMs of international distribution (science and technology, ecology, travels, arts, history, social sciences, hobbies, sports, and games). In table #1

Table 1. Multimedia Systems Off-line Analyzed

All Movie Guide; Anatomia 3D; Argentina Vision; Astronomical explorations; CD atlas; Autodesk Texture Universe; Castelos de Portugal; Cdull; Cuba; Curso de Windows; Diccionario de la Lengua Española; Einstein; El Museo Thyssen Bornemisza; El teatro mágico; Encarta; Encicopledia del cine español; Enciclopedia del Universo; Encicopledia Zanichelli; Garden Encyclopedia; Green Bear; Historia Universal del Arte; Instrumentos Musicales; Kiyeko; La aventura de los dinosaurios; La máquina del tiempo; L'Egitto dei Faraoni; Maps Facts; Multimedia Beethoven; NN'n Toy Markers; Peter y los números; Rayman; Red Rhino; The Complete Herman; Travel Talk; Velázquez; Wild Board Games; World's Greatest Classic Books; Peter Gabriel's Secret World, Van Gogh and Zoo.

are described the off-line multimedia systems which have been used to analyze the static and dynamic graphic components that have been analyzed.

The verification process of the presented methodology consisted firstly in the assessment in a usability lab and secondly in the elaboration and assessment of the applications developed for the UOC [14]. Other heuristic assessors and users have intervened in the verification. Some of these assessors have worked inside a usability laboratory. The users who have taken part in the assessment belong to two categories: expert and inexpert in the use of multimedia systems. Next, the obtained results and in brackets the percentage of the presence of the design component that has been assessed is depeicted:

Table 2. Heuristic Evaluation of Communicability Design

- The sound is present in most of the analyzed multimedia systems (75%)
- The sound prevails in relation to the animations and the video (25%)
- The sound is the most used device to draw the attention of the user in the navigation (20%)
- The audio is the device most used to foster the navigation in the analyzed systems (20%)
- In the base texture of the screens there prevails a combination of texts, colors and images (25%)
- The lighting effects that prevail are of the ambient kind (50%)
- The 3D simulations prevail in the 3D with shadow edges (45%)
- The 3D objects are simply presented with a final rendering (25%)
- The 2D animations are the ones that prevail in the interface (55%)
- The explanation of the functioning of the system lies in an help option (75%)

These results which encompass several design categories also enable the designers to have a state of the art summing-up of the commercial multimedia systems off-line in the decade of the 90s. We can see the quality results by categories of design in the annex # 1. The results obtained in the assessment with users inside the laboratory have made it possible to elaborate a list of actions and conclusions which are next presented:

- Usability must be divided into several levels. One can start from very general problems which are common to all the interactive systems and go to the specific problems of specific systems. That is to say, at a first level there are the interactive systems in general terms; at a second level the categories of systems such as are the hypermedia or the multimedia and at a third level the kinds of systems, such as for instance an information stand at a museum. In each level there must be a preparatory stage, a listing of abstract tasks and a set of assessment criteria.

- Upon evaluating a multimedia/hypermedia system it is necessary in the first place for an inspection by an expert in heuristic assessment of multimedia systems. The results of the inspection are: some application outlines, a list of the potential problems and a set of abstract tasks. The tasks must be specific activities for users in the heuristic assessment.
- Empirical evaluation is more effective in relation to the quality of the results and cost when there is a list of abstract tasks.
- The inspection of the expert must be efficiently combined with the empirical assessment.

5 Conclusions

The heuristic assessment carried out by the communicability and usability expert in the current systems and those in off-line multimedia supports have confirmed the obtained results with the tests made in the usability laboratories in the past decade. Counting on a usability and communicability expert is very positive since it allows the tasks the users must carry out at the moment of the test to be established beforehand. Having precise tasks available allows money to be saved since the designer knows beforehand the possible inconveniences that the users will find at the moment of interaction. In the current work it has been detected how in the multimedia systems made with open source software, they maintain many of the design components of the off-line multimedia systems of the nineties. Therefore, in the current work it has been seen that it is important to consider those educative systems and adapt them to the on-line contents. In the case of the text, which is one of the design categories that prevail in the current on-line interactive systems, it is necessary to resort to organization in the shape of an inverted truncated pyramid. The presented quality attributes and the multimedia design components that have lasted throughout time will be immediately applied in the realization of multimedia products for a virtual campus.

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Annex #1: Evaluation of Multimedia Systems