The Interface Design for Learning Environments via Web Using the Multiple Intelligences Theory and the Ergonomic and Usability Criteria

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ABSTRACT

Nowadays, the success of distance learning environments via web depends mainly on a well-designed interface for the user because teachers and learners are physically in different places and time. So, the instructional interface development process is a great challenge for distance education courses offered in these environments. The goal of this paper is to propose planning and methodology strategies to develop interfaces using the Multiple Intelligences Theory according to ergonomic recommendations and usability. It is also presented an application of the proposed methodology in the Natural Sciences in Education I course-discipline of the Pedagogy Undergraduate, Program, one of the six bimodal undergraduate courses offered by CECIERJ Foundation/CEDERJ Consortium. This Consortium is a partnership between the government of Rio de Janeiro State, Brazil, and six Public Universities located at Rio de Janeiro city.

INTRODUCTION

In a computer-based training environment, instructional interface elements should be those that are specifically designed to facilitate the learners´ access and participation. Fundamentally, their learning process once teachers and learners are physically in different places and time. This means that the success of the learning process in these environments depends on a well-designed user interface to help learners to guide themselves through instruction (Lohr, 2000). For this reason, ergonomic recommendations and usability in a design project should be considered.

On the other hand, the Information and Communication Technologies (ICT) progress are helping teachers to follow individually the learning process of their students. The ICT can also make possible to elaborate interfaces for web environments which can provide the student comprehension throughout symbol systems (linguistic, numerical, musician, graphic etc.), facilitating learning process for different cognitive styles. So, ICT are perfect to apply the Multiple Intelligences (MI) Theory approach defended by Howard Gardner (2001).

The goal of this paper is to propose a methodology to develop distance education interfaces for courses offered via web using the MI Theory according to the ergonomic recommendations and usability. It is also presented an application of the proposed methodology in the *Natural Sciences in Education I* course-discipline of the Pedagogy Undergraduate Program offered by CECIERJ Foundation/CEDERJ Consortium.

THEORETICAL FOUNDATION

Some important concerns (as ergonomic recommendations, usability of instructional interfaces) and the MI Theory that were fundamental to elaborate the methodology proposed in this paper will be developed now.

Ergonomic Recommendations and Usability of Instructional Interfaces

Hackos et al (*apud* 1998) and Marchionini et al (1995 *apud* Lohr 2000) showed that:

"The user interface is formally defined as the communication link between an environment (a product or system) and an user. It consists of objects or elements designed to communicate the function of the environment. An instructional interface by this definition can be thought as the elements that assist the user, a learner, in the task of learning. In a computer-based training environment, instructional interface elements are those that are specially designed to facilitate access to, and participation in, instruction and instructional support."

In agreement with Lohr (2003), the project of an educational interface is a challenging effort that requires instructional design and educational project knowledge as long as human and psychological factors, ergonomic research, computer sciences and publishing project. Many recommendations are available to attend the designer professional, but many among them do not fulfill with the specific necessities for educational environment. Nilsen (2000) says that "*many of the existing environment interfaces present problems in the information architecture, visual elements organization, interactivity and functioning"*.

Hall (2000 *apud* Silva , 2006) detaches that education based on web depend on the target public, the communication context and the virtual environment. Although designers must face these questions, a web-based course should consider the learning objectives which are the most important factors in guiding the entire creation process of the project development.

In this way, Fleming (1998) proposes to observe how people study in the internet and how are their expectations when using the learning environment. The interface should provide the knowledge of how a student should answer questions related to the browsing and to the learning.

Finally, it is important to understand that the interface design project for learning environments via web have to consider the target public identification (user), his/her objectives and tasks. Then, when the ergonomic and usability criteria are applied the quality of the interaction is guaranteed due to the teach-learning process.

The Multiple Intelligences Theory

The MI Theory (Gardner, 2001) can help a teacher to organize his work and to know well his students. This fact will be possible through a set of categories used to describe strong and weak characteristics of the students, within a special recommendation to avoid prejudices and/or stereotyping them [p.185, 186]. Using the MI Theory is easier to assign subjects, teaching methods, hardware, software and ways of evaluation in order to considerate the most strong intelligences that are revealed by the students.

At the beginning of the Eighties, Gardner has initially identified seven different human intelligences: the *linguistic intelligence* (sensitivity to spoken and written language, the ability to learn languages, and the capacity to use language to accomplish certain goals); the *logical-mathematical intelligence* (capacity to analyze problems logically, carry out mathematical operations, and investigate issues scientifically); the *musical intelligence* (skill in the performance, composition,

and appreciation of musical patterns)*;* the *bodily-kinesthetic intelligence* (potential of using one's whole body or parts of the body to solve problems); the *spatial intelligence* (potential to recognize and use the patterns of wide space and more confined areas); the *interpersonal intelligence* (capacity to understand the intentions, motivations and desires of other people)*;* the *intrapersonal intelligence* (capacity to understand oneself, to appreciate one's feelings, fears and motivations).

From 1997 and on, Gardner (2001, p. 63-79) has been identifying more three "new" possible *intelligences:* the *naturalistic intelligence* (applied to people who demonstrate great recognition and the classification of its environment); the *spiritual intelligence* (spiritual human predispositions) and the *existential intelligence* (capacity of pointing out the meaning of the life, the direction of the death, the final destination of the physical and psychological worlds).

There are some meaningful works in Education using the MI Theory. The SUMIT (Schools Using Multiple Intelligence Theory) Project, for example, was a 3-year national investigation which has involved 41 schools in the United States. It sought to identify, document, and promote effective implementations of MI. After this study, 78% of the schools have declared positive results in standardized tests; 63% have associated this success to the pedagogical practices used and based on the MI Theory; 78% have declared that there was an improvement in the learning process of the students with learning problems; 80% have declared an improvement in the participation of the parents and 75% of them have attributed the improvement to the MI Theory; 81% have declared that the students were more disciplined, and 67% of them have attributed this improvement on the students' behaviour to the MI Theory. Although these numbers can reflect an emphasis positive, it is also important to say that they were based on empirical data, that cannot be refuted by anyone.

Vicari (2005) has developed an experiment at Paulista University in São Paulo State, Brazil, which involved the application of learning activities with undergraduate students of Production Engineering. The MI Theory was applied as a pedagogical strategy on the learning process. The experiments have the intention to verify whether learning contents presented, according to the student profile, could facilitate the learning process, and whether learning contents not adjusted to the student profile could make the learning process more difficult. 92 experiments were taken: 41 according to the student profile and 51 in contrast. The percentage of consonant contents was higher than the percentage of conflicting contents. The conclusion of this case study was that in distance learning, when there is a previous knowledge of the student profile and individual learning styles based on the MI Theory, it is possible to present an adequated way in order to obtain better results in learning process.

The VLSM is an adapted model aligned with the philosophy of Saskatchewan Education University (Boulton, 2002). The virtual teacher´s task is to scaffold learning to support the learner in the use of VLSM design elements: layer 1- Instructional Strategies; layer 2- Multiple Intelligences, layer 3- The Organization Models; layer 4- ICT Genre. The layers of VLSM demand online instruction to utilize many different combinations of the four layers in order to meet different intelligences and learning styles (Witfelt, 2000 apud Boulton 2002). In the second layer (Multiple Intelligences), teachers will need to examinate their pedagogical beliefs and take into consideration the theory of Multiple Intelligences (Witflet, 2000; Bisho et al, 2001 *apud* Boulton 2002). The MI Theory suggests several other ways in which the subject material may be presented to facilitate effective learning. Meeting individual learning needs can be accomplished through the use of eight potential individualized instruction pathways.

CONTEXT OF THE CASE STUDY

CEDERJ Consortium (Distance Undergraduate Education Centre of Rio de Janeiro State, Brazil) is connected to SECTI (Innovation, Technology and Science State's Secretary of Rio de Janeiro) and associated to six Public Universities located at Rio de Janeiro city (UENF, UERJ, UFF, UFRJ, UFRRJ and UniRio). Since 2001, some bimodal undergraduate courses are offered: Computer Science, Biological Sciences, Mathematics, Pedagogy (Initial series of K12), Physics and Administration. The main goal of these courses were to socially include the students who can not study in a local University. In 2007, it will be offered some other courses: Chemistry, Geography, Pedagogy (complete course) and Modern Languages. Actually there are 14.000 registered students and 20 (twenty) regional centres spread all over Rio de Janeiro State prepared to assist the students during the course. The contents of these courses are developed by teachers who work at the associated Public Universities and edited by the CEDERJ staff to adapt the written pedagogical material to be presented in two ways: publishing and web-based material. Specifically for the web-based instruction, there are four multidisciplinary departments and each one responds for Biological Sciences, Mathematics, Physics and Pedagogy developing material (Silva, 2006).

The Pedagogy Program of CEDERJ was created to be completed in 3 years learning period, along 30 and 60 hours course-disciplines. There are mandatory courses-disciplines and others which are eligible by the student, according to the teaching methodology. The course-disciplines are offered to the learner through didactical printed material, digital material and web classes at CEDERJ e-Learning platform (http://www.cederj.edu.br). The students have presential and also long distance tutors to help them on the learning process. Long distance tutorial can be accessed through a public telephone, fax or at CEDERJ plataform. The tutors can use didactical printed material and web classes during tutorial meetings.

THE DESIGN OF WEB-BASED INTERFACES USING THE MI THEORY

This item describes planning and methodology strategies to develop distance education interfaces for web courses using the MI Theory accounting as also ergonomic recommendations for usability. It is also presented an application of the proposed methodology in *Natural Sciences in Education I* course-discipline of the Pedagogy Undergraduate Program of CEDERJ Consortium.

Planning Strategies to Design Web-Based Interfaces Using the MI Theory

In traditional "face-to-face" classrooms the teacher conducts, helps and promotes educational and learning process. On web classes, however, the interface should transmit the idea of being in an environment built especially for the student with an appropriated design. Moreover, the instructional interface design should offer a rich learning context minimizing the loneliness feeling, a frequent complain of distance education learners. Thus, a distance education interface via web should offer several resources in order to accomplish the learners-target needs, according to their individuality, their real life environment and also the aims of the learning activities. For planning and using learning strategies in the interface's design of a course-discipline, it must be considered (Silva, 2006):

- Target public (learners): identification of the system's user;
- Contents: what is accosted by each discipline/course and its pre-requisites?;
- Strategies: the relation between the course-discipline aims and daily matters;
- Concepts: which concepts have to be given to the target public (learners)?;
- Function: the course-discipline function related to the program;
- Mission (goals): course-discipline goals related to the program;
- Tasks: activities which have to be accomplished by students using the interface;
- Cognitive styles.

These eight elements above should be considered in order to create a metaphor conception that will be used in the hole interface design to construct the course-discipline environment for the web. The web designer should concern about the text language of each screen, so that the interface will not function only as a background. In this way, it is important to create a context and a visual identity that enables the discipline contents' organization and the insertion of learning activities inside the designed interface.

Resources or situations such as, for example, a video sample, are organized or included in the interface to promote the learning of a content / subject / theme. The function of this survey for the metaphor creation is to enrich or to propose an interface with interesting learning situations that help the student to attend a video, read a text, to participate on a debate about some subject with his classmates. These situations should be associated to different learning styles of the students and should contemplate all the multiple intelligences.

For Fleming (1998), it should be given opportunities for visual learners to view pictures or diagrams, for verbal/textual learners to hear and read explanations, and for active learners to learn through discovery or experience. It sounds quite daunting, but it's not as hard as it seems. Providing these different opportunities will make learners feel more at ease right from the start and will help ensure that they are not turned away by an approach that does not address their needs.

The ICT progress was made to become real the MI approach defended by Gardner. It is already possible to create computer programs or software directed toward different intelligences, programs that offer a variety of entry points allowing the students to demonstrate their understanding in various symbols systems (linguistic, numerical, musical, graphical etc.) (Gardner, 2001).

Applying the Strategies to the Interface Design of the Pedagogy Program of CEDERJ Consortium

The Education web staff is a multi-disciplinary team, composed by a coordinator and an instructional designer, both undergraduated in Education. There are also web designers, animators, illustrators and programmers.

The coordinator assembles the printed educational material of a particular course-discipline of the Pedagogy Program and selects a group composed by an instructional designer, a web designer and an animator/illustrator to work on the contents. Then the work starts in order to implement 15, 20 or 30 course-discipline classes, according to the hours required on the program. These groups are selected considering the qualification and individual features of the components.

After the planning stage described above, it is necessary to create a script to be followed by the workgroup, guided by the steps to elaborate and to implement the interface design or the web classes of a course-discipline as seen next:

Step 1. Workgroup meeting to define the discipline's web design;
Step 2. Meeting with the instructional designer, responsible for writing the texts of the web classes;
Step 3. Elaboration and implementation of the course-discipline design/environment;
Step 4. Teacher's approval;
Step 5. Applying usability tests for the evaluation of the course-discipline interface by the students and tutors (Silva, 2006);
Step 6. Final design and course-discipline implementation;
Step 7. Upload of the web classes on CEDERJ platform allowing the students´ access.

IMPLEMENTED INTERFACES

The interfaces are elaborated/designed by the illustrator/animator responsible for the discipline using Adobe Flash software. Each layout corresponds to a .fla file. The instructional designer is responsible for the content elaboration of the web classes which are based on the text of the published material. Therefore, he/she has to select videos, internet sites, games etc., to include them in the interfaces. When the instructional designer has finished the content elaboration of the web classes, the web designer will implement them by producing .swf files. Finally, these .swf files will be published in a .php page at CEDERJ platform. This platform is a framework which corresponds a distance education environment known as a CLMS – Content Learning Management System.

The implemented interfaces of the course-discipline *Natural Sciences in Education I* are static due to the specifications of CEDERJ platform. It does not allow a frequent interface update because it has been attended by a great and crescent number of users. However, in the second semester of this year, a new version of the platform will be implemented and it will be possible to receive dynamic interfaces.

It will be showed now some implemented interfaces using the planning and the script already described for web classes elaboration related to the course-discipline entitled *Natural Sciences in Education I* of the Pedagogy Program. The TV interface has been designed to associate each channel to an special intelligence proposed by Gardner. Then, each channel tries to show the discipline content in a way that stimulates the cognitive style of the individual student that is associated to an intelligence type.

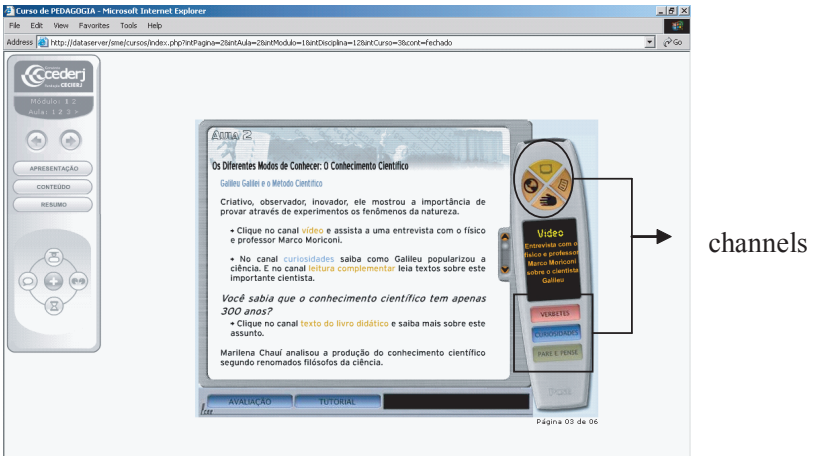
As long as the design and the implementation of interfaces stimulate many intelligences types, it allows the student to access pedagogical activities that are more related with their cognitive style facilitating the learning process.

The dynamic of this course-discipline in the web is a TV program with two characters: "Gil Terra" and "Ana Soe". The content of the lesson is presented in a TV screen inviting the student to guide him/herself by choosing TV channels.

Figure 1 presents the text with questions regarding the subject presented in the lesson, and guides the student towards TV channels where he/she may access videos, published didactical material, linkage, suggestion of activities etc., all intended to be carried throughout their professional career as teachers.

To Access the complementary video of the classroom, the student should click the video channel (Figure 2), where is possible to attend interviews, news, and documentaries related to the subject presented in class. This type of Learning Activities (LA) is for verbal and textual learners to listen and read explanations (Fleming 1998). For Gardner, this LA stimulates the *linguistic intelligence.* For the practical activities it is necessary to click on the channel entitled "practicing in the classroom" (Figure 3). For Gardner, this LA stimulates the *bodily-kinesthetic intelligence* because it invites the student to use his/her body (as the hand or the mouth) to solve problems or to create products. This LA also stimulates the

Figure 1



The TV Screen
< http://www.cederj.edu.br/cecierj/> Retrieved September 26th, 2006

Figure 2

The screen with the video channel – *linguistic intelligence*
< http://www.cederj.edu.br/cecierj/> Retrieved September 26th, 2006

Figure 3

"Practicing in the classroom" screen– *bodily-kinesthetic and naturalist intelligences* < http://www.cederj.edu.br/cecierj/> Retrieved September 26th,

naturalist intelligence as the student can build some instruments to study Nature. To access the internet sites that are recommended in the class, the student should click in the channel entitled "complementary reading" which, in agreement with Gardner, should stimulates the *linguistic intelligence*, the *musical* and the *logical-mathematical intelligences* too.

At the "stop and think" channel (Figure 4) active learners will learn through discoveries or activities (Fleming 1998) by accessing animations, videos, texts or games, synchronized to the *logical-mathematical and the intrapersonal intelligences* (Gardener 2001). Finally at the "Comments" channel (Figure 5) the learners can discuss the themes presented in the course-discipline to improve their *interpersonal intelligence* (Gardner 2001).

CONCLUSIONS

The educational interfaces should be developed to enhance a new knowledge acquisition, academic abilities and attitudes which are necessary for their career. In consonance to this, it is fundamental to know the learners´ cognitive style because from this stage it is possible to decide about the curricula, the pedagogy and the evaluation methods. Another important aspect is that the educational decisions will be taken based on a up to date student profile. The application of the MI Theory and the ergonomic and usability criteria during the planning and design of the interfaces for learning environments based on the web can facilitate the settlement of an enriched environment that: 1) present learning situations where the information organization will reach the interests and the preferences; 2) minimize learners´ troubles; 3) identify the experiences and the objectives of each learner; 4) reach the educational objectives established at the beginning.

ACKNOWLEDGMENTS

We would like to acknowledge Teacher Carlos Eduardo Bielschowsky, the president of CECIERJ Foundation/CEDERJ Consortium and Teacher Roberto Paes de Carvalho Ramos, who has reviewed this paper.

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Figure 2

"Stop and Think" channel – Game - *logical-mathematical intelligence*
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