Graphic design: A sustainable solution to manage the contents

of teaching materials

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Abstract: There is a concern that the teaching of subjects is applied not only with support from a set of technological devices, but largely in the proper use of teaching and new technologies. Taking this idea, the authors develop a research and sustainable design that result in educational materials in solid content and technological innovation, also to have the benefit of learning process of a particular subject. The project is in its stage of development of educational materials, which indicates that only the experiment is missing.

Key words: education; design; sustainability; ICT; teaching materials

1. Introduction

As in every period of history, there has been a change or revolution in the way of access to knowledge, the emergence and rise of ICTs (information and communication technologies) said by Garcia and Cabero (2007) have helped increase and facilitate access and exchange of information in greater quantities and at greater distances in less time, in addition to storing increasingly smaller spaces. It has made a significant change in the way of working, interacting and learning, whose impact has affected all areas of actual life.

Derived from this, the public institutions of higher education in Mexico face the challenge of the widespread introduction of ICT in classrooms, which are coupled with the phenomenon of globalization implies developing and implementing new proposals in the curriculum and in its administration by establishing a series of changes in education, whose primary purpose will result in the consolidation of a project to make consistent academic preparation of students for professional practice, which will refer among other things in improving the quality of teaching as well as the use of technologies that are also considered sustainable.

In that sense, the concept of sustainability, "... development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs", being presented in 1987 in the Brundtland report, is closely linked to sustainable development which was first used in 1972 at the Stockholm conference on human environment.

That initial vision of sustainability has become a more comprehensive definition that includes many other aspects related to quality of life or even alludes to a specific activity carried out by men particularly like the graphic design.

This professional, whose creative function is focused on being a facilitator between the customer and the product, creating forms or elements that meet certain needs, must have the ability to adapt to new circumstances

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and approaches in this competitive world that demands any activity. Its goal is to create a finished product, practical and functional but also sustainable.

Designing for a sustainable development involves identifying new ways, being more efficient and more direct to satisfy needs and emphasizing the benefits of the produced product rather than the product itself. Sustainable products should minimize the use of nonrenewable resources and the production of waste during its life-cycle, giving as a result of a benefit or utility to the user.

Educators more frequently situate the ICTs in the forefront of innovations that operate in the educational system, fact said by Gispert (1997). It is supported by parents, who often expressed the feeling that modern ways of information are key to school success for their children.

This fact is reflected in the *World Declaration on Higher Education for the 21 Century* and quoted by Chaires (2002), which states that, "The new pedagogic methods also will imply new teaching materials".

Thus, the inclusion of ICTs in schools will have to carry out the corresponding actions to incorporate strategies that reinforce the topics of the programs that are taught in them, as well as the creation of teaching materials adapt to these new technologies.

In this regard, they have conducted several investigations, which have been joined since the use of videoconferencing to the application of interactive multimedia CD-ROM format.

Some of this work is listed below:

(1) EDUSAT (education satellite) is a compressed digital signal that is transmitted via satellite, the most important of whose kind is in Latin America. It depends on the Ministry of Public Education (SEP) and its main function is to make available to a wide range of Mexican television and radio for educational purposes (Garcia, 2005).

(2) The ITESM (Institute of Technology and Superior Studies of Monterrey), Campus Estado de Mexico, developed a LDI (digital interactive laboratory) of inorganic chemistry, using an interactive simulator within the framework of constructivism in education and whose main purpose is to promote environmental protection and development of skills and attitudes in students enrolled in the subject (Garcia, 2005).

(3) Perurena developed a research on the construction and implementation of multimedia courses that have been used in the model of present and semi-present teaching in which teachers have the challenge of using ICTs in creative ways (Perurena, 2006).

(4) Finally, Cabero and Garcia presented a research project that describes the process followed for the experimental design, implementation and evaluation of an interactive multimedia CD-ROM, for which were used as variables of study the different types of learning, academic achievement, attitude and perception of this medium, whose final and main objective would be to determine the effectiveness of this technological resource in its applicability in the teaching-learning architecture (Cabero & Garcia, 2007).

In this sense, the FADU (Faculty of Architecture, Design and Urbanism) from the UAT (Universidad Autonoma de Tamaulipas) in mid-2007 launched a joint effort with the principal administration to provide much of their classrooms technology infrastructure that will facilitate the transmission of knowledge and improve quality in the teaching-learning process.

This could lead the teachers to adjust or change their model of teaching by adhering to the common use of new technologies. Therefore, it started in the same year a process of teacher training to get in the field of technology, so that it would be able to incorporate technology that was posted today on the name of "smart classrooms", called like that because they have been equipped with cutting edge technology to support teaching-learning process.

Considering all this and on the grounds stated by the Committee for the Evaluation of Higher Education (CIEES, 2000), which stated that it would require a teaching strategy that allows promoting collaboration and participation of students and teachers, respecting the different speed of learning among other things.

(1) Does the technology implemented in the classrooms will be adequate to facilitate the transmission of knowledge and improve the teaching-learning process?

(2) Were courses implemented by the administration of the FADU-UAT to teachers in the management of this technology enough so they could successfully incorporate the technology in their teaching of their classes?

(3) Do teachers use didactic materials whose support is through one of ICTs, by this case, how is the design of the same?

(4) Could graphic design as a discipline dedicated to visual communication, plan correctly the necessary elements to the correct development of didactic materials which can be regarding as sustainable?

Knowing that the act of migrating information to a digital support is not easy, the last of the questions was taken as the main focus for the research project to design a teaching material from the platform of interactive multimedia CD-ROM to perform the teaching-learning process in FADU-UAT, but integrated within the proposed methodology in the execution of the power to respond to each of the first 3 questions.

Also in the projects objective is the fact that this material could be sustainable, so when it incorporates as an integral part of the subject, it could avoid the excessive use of paper to integrate all the information that professor intends to convey in his class in a single medium.

2. Methodology

To carry out the experiment, it was divided into 2 goals:

(1) The first goal consists of collecting information to analyze the first 3 questions raised above and which impacted on the period of spring 2008;

(2) The second goal, made during summer to autumn, 2008, would cover the stages of design, implementation and evaluation of the CD-ROM for a subject on the current curriculum in FADU-UAT.

The project was further subdivided into each goal, in a series of steps that would allow more time to punctually achieve each of the planned goals.

Regarding the first goal, it set the following steps:

(1) Narrowing conceptual and structurally the project;

(2) Determining which subject would be taken as a basis for implementing the didactic materials and management of content using graphic design as a generator of sustainable educational or didactic materials;

(3) Spatially restricting the study area;

(4) Designing a data collection instrument that allows to collect and then analyze the technological infrastructure. This information will be collated with the Department of Software and Hardware of the same institution;

(5) Designing a data collection instrument that allows to collect and then analyze the effectiveness of the implemented courses for professors of the FADU-UAT in the use and incorporation of ICTs in their courses;

(6) Requesting to the secretariat of the academic FADU-UAT the information of spring 2008 period of professors of the FADU-UAT, regarding the delivery of their courses and specifically how they used ICTs on the curriculum integration;

(7) Determining the universe and the study sample for analysis of the variables established for the project in the period from autumn 2008;

(8) Designing a data collection instrument to measure the variables set for the project in the period from autumn 2008, such information would be provided by the academic secretary through (a) way of teaching; (b) use of ICTs and teaching materials by the professor who taught it; and (c) opinions of students about the use of ICTs as well as the design of teaching materials used by the professor;

(9) Analyzing the information provided by the professors and students of the FADU-UAT, regarding the use and integration of ICTs in the curriculum materials as well as the effectiveness of teaching materials used by teachers.

Regarding the second goal of the project, the central idea of interactive multimedia design was that learning should not remain in an area of virtual concepts only, but that knowledge had to be linked to other knowledge previously acquired for having a whole a higher meaning and could be applied to solve problems in personal activities, academic or professional of the student.

This process meant to cover the following stages:

(1) Identifying the profile of students;

(2) Establishing the goals of media material;

(3) Defining the specific objectives, activities, learning strategies and assessments of each individual learning unit;

(4) Defining and designing the structure of the multimedia course to provide the same it was established and the most relevant aspects it should cover: (a) flow diagram; (b) identification of main screens; (c) ichnographic elements characteristic of the teaching material; (d) info-graphics layout; and (e) interface layout;

(5) Organizing the instructional materials and selecting the visual media for transmission;

(6) Elaborating the contents, activities, learning strategies and assessments of each individual learning unit;

(7) Integrating all information into a single medium;

(8) Designing planning multimedia teaching material;

(9) Evaluating the effectiveness of the medium if it meets the characteristic of being sustainable.

The structure was established for the media of the selected area, roughly having the following characteristics:

(1) Having the option to view the introduction to the pace you want, or skipping if having already displayed;

(2) Being always available on the main menu items for the same side;

(3) Accessing without further requirement for any of the items or items that comprise the multimedia side;

(4) Having the option to end the session at any time, without having to return to a particular screen.

The selection of software to be used for the construction of each individual component, such as images, text, audio, among others, as well as, which will integrate all these individual components and operate as a single device, was based on 2 premises that were the most effective for the stated purpose and that a member of the team was expert in its use.

To modify images, it used the Photoshop program, which will touch the previously digitized photographs, as well as Corel Draw to redraw the pictures take the script as technical.

As for the texts, the authors used the program Microsoft Word, because it is the more compatible with all programs working on the Windows environment.

However, to integrate all these elements into one, the authors used the program flash, which due to the characteristics of its interface, played the specific roles in the creation of multimedia material.

There were realized 2 stages of review: The first stage is by a group of researchers and the second stage is for

users to whom it intended the interactive. Of the obtained results were made adjustments and changes suggested by the research group and users, which result in a second alpha-test version to be implemented later in the experimental testing conducted in spring 2009, which will finally measure the degree of sustainability of the designed educational materials.

To use the interactive multimedia, it required from a user: (1) minimal knowledge of computing; (2) minimal knowledge of the management of peripherals; and (3) management of minimal Windows environment.

Apart from these concepts concerning the management of computer systems, the interactive does not require any specialized knowledge on the subject, rather than acquired during their transit through the curriculum of the FADU-UAT.

To make the implementation and evaluation of multimedia, material was determined to use a quasi-experimental design, because the group selected as the experiment would not be handled, since it was formed in advance.

The quasi-experimental design was determined as follows:

(1) The research would consist in measuring the effectiveness that the interactive multimedia would have to facilitate the transmission of knowledge and improve the teaching-learning process;

(2) The interactive multimedia was designed, applied and evaluated on the subject named Mexico design analysis of the plan millennium III in the school period autumn 2008. The multimedia content would be based entirely on the topics that include the above plan;

(3) The experiment was administered to all students enrolled in the selected group as sample and formed by the department of school in the period in question;

(4) This experiment, by its nature, involved the active participation of the professor; to facilitate the issue, a member of the research group was the professor of that subject in the period indicated. It was requested approval from the administration of FADU-UAT to conduct the experiment at the established conditions;

(5) The project was implemented as a pilot test phase for a period of 4 weeks from 14 weeks which includes the fall 2009 school period;

(6) The selected period were 10-13 weeks of the period mentioned, due to the changes suggested and made by the research group in the first multimedia interactive;

(7) In those weeks, it gave the student copy of the interactive multimedia CD-ROM to use under the plan established as teaching materials in the teaching-learning process;

(8) During the pilot, it would evaluate the study variables, by using the tools of data collection for this purpose were selected or designed.

3. Results

Until the time of drafting this document, it is only the analysis that allows to establish the results for the phases of analysis of the technological infrastructure, as well as the use by the teaching faculty of ICTs and teaching materials, from which conclusions can be obtained.

Having the phases of analysis, results with respect to the opinions of the students have the ease facility, with which ICTs pass knowledge and improve the teaching-learning process, as well as evaluate the media material as a sustainable learning resource used by the group of the pilot experiment in fall 2008.

Regard to the infrastructure, the results are as follows. The FADU-UAT consists of 5 buildings that are used

for teaching classes for both theoretical and practical subjects (A, B, C, D and G), lab materials (F), library (E) and Cultural Center (H), which comprises 2 rooms and an auditorium for conferences, as illustrated in Figure 1. The administrative area is located on the second floor of Building A.
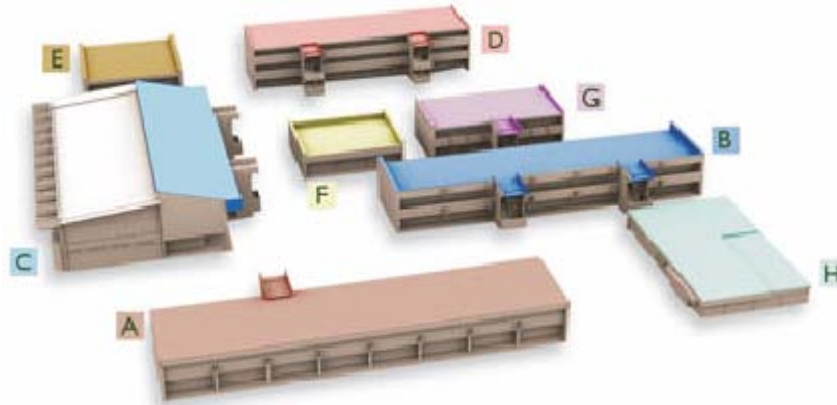

Figure 1   Distribution of buildings in FADU-UAT

To properly perform the research project, it was necessary to establish a special limit for the application of the experiment in the analysis of the technological infrastructure, as well as analysis of the delivery of lectures by teachers, for the tests, Building D was established.

The main reason for choosing it is that of the 5 that are used to teach, this is the one with the largest number of classrooms (14) and that unlike the past, when the authors began the experiment, it was the one which had introduced the latest technology to teach.

Each of the rooms of this building is equipped with the following equipment: PC (personal computer) with monitor and speakers, video projector, document camera, interactive whiteboard and VCR (video cassette recorder). The rooms also have to support the delivery of the materials a blackboard and a white cork, as shown in Figures 2 and 3, respectively.
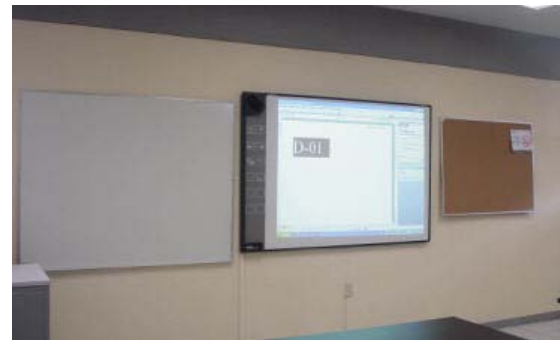

Figure 2   Technological equipment installed

Figure 3   Set of classroom blackboards

Likewise in all CPU (central processing unit) is installed the following software: intelligent interface board, basic office package (Word, Excel, PowerPoint, Access, FrontPage), image viewer, video viewer, acrobat reader and specialized packages for the degrees of architect and graphic design, such as AutoCAD, Corel Draw.

This is with the intention that the teachers can use any kind of teaching material prepared for class meeting and interacting with the board and the group of students (see Figure 4).

Figure 4   Interface of the intelligent blackboard

Figure 5   Internet connection

Likewise, in order that professors can use the databases employed by UAT or simply so they can incorporate the use of the Internet into their classrooms to improve teaching-learning materials, all of the rooms that have CPU have been connected to the Intranet of the university through a wired connection which allows access to almost all the Web pages for educational purposes (see Figure 5).

Regard to the use of ICTs and teaching materials by professors, the obtained results are as follows. To make the analysis of teachers in the use of ICTs and materials in their classes, the administration requested the FADU-UAT, providing the time distribution of the classes assigned to the autumn 2008 period. This was intended to establish the power of the universe and obtain the sample of the study.

The total of classes assigned to Building D in the above period was 187 subjects. Therefore, for the sample, it was decided to establish criteria as a maximum acceptable error of 5% with a confidence level of 90%, resulting in a total of 111 subjects as part of the sample.

The elements of the sample were determined under a simple random process, leaving only one established as criteria for inclusion that the professor would like to participate in the process.

It was also established that, if a professor had been selected in 2 or more subjects, he/she was asked to determine whether the criteria for delivery in the first field survey was applied to the second or third area which provided. This indicates the result of an effective sample of 35 professors surveyed.

Of these, it can highlight the following results:

(1) Of the total respondents, 15 were men and 20 were women;

(2) The average age was 42 years, having the youngest professor 28 years of age, while the oldest was 63 years;

(3) Twenty-one were with architect degree, 7 graphic designers, 3 civil engineers and 4 of other professions;

(4) Eleven said they hand over notes in digital format to 14 who ask their students who take copies of books;

(5) Twenty-three recognize to use few PC/Video projectors to teach their classes. Of those who use it, nineteen mostly use it for PowerPoint presentations;

(6) Twelve believe that their presentations are between excellent and good design, taking as reference the variables: animation, color contrast, image contrast, density of text, text size and images, among others;

(7) Twenty-one do not use the smart interface board, using it only as a white board or as projection area;

(8) Twenty-six have never used the document camera or VCR;

(9) Of the 22 teachers surveyed did not recognize how to use technology to improve the teaching-learning process;

(10) Thirty-one teachers say they have used various non-technological didactic materials that facilitate learning as specified in the same objectives of the class as well as learning activities, while recognizing that the vast majority of their students react to so little effect on the interaction in it, by reference to the following: taking notes, participating spontaneously, asking about the issue, responding appropriately when they are questioned, among others;

(11) Thirteen use only the white board of the 3 boards installed in the classroom;

(12) Twenty-four teachers took the training course taught by the FADU for the use of ICTs installed, which it considered appropriate and sufficient for its use and application in their classes;

(13) Fifteen teachers have taken courses on the design of instructional materials by the FADU, which it considered appropriate and sufficient for its use and application in their classes.

Finally and regarding the result of the implementation of CD-ROM on the subject selected for the research, the sample group was conformed of 22 students enrolled in the autumn 2008. This has a favorable acceptance by the students regarding the application of graphic design as an aid to teaching the subject.

Interactivity was evaluated satisfactorily as not been required support or external information of the student to use the CD-ROM.

The design of the digital teaching tool was considered by the sample as appropriate in the design of its proposed structure and graphics, as well as the distribution of space, color and content management.

The contents were evaluated successfully in quantity and distribution, considering that they included a concrete and objective summary of the specified matters in the institutional agenda of the subject.

As for learning opportunities, the fact confirmed by the analysis of data shows that the students recognize a higher learning through the use of this teaching material.

In summary, research results show that the CD-ROM can be used on a self-taught, allowing the material to cover its sustainability by making it be used many times by the students when required, avoiding this reproducing forms from various sources, such as photocopies of books, digital files, among others.

4. Conclusion

Based on the results of research done on concrete and the 4 questions raised initially, it can be concluded that:

(1) With regard to the technological infrastructure that has been found, the researchers say that the rooms called "smart classrooms" in Building D of the FADU-UAT meet minimum quality standards required to significantly improve the quality of education and facilitate knowledge transfer and improve the teaching-learning process. So all teachers who taught classes in these classrooms might have designed teaching materials to be used through the installed technology;

(2) Although teachers acknowledge that they have been trained in the use and implementation of it, it is clear that this knowledge does not really permeate the classroom, as the teachers continue to use a more traditional teaching-learning process, not having a clear idea of how to use ICTs to support teaching in their subjects;

(3) With respect to management of learning materials using ICTs as a support within the classes by teachers, it can be concluded based on the results that using PowerPoint, as a teaching resource technology is more effective for transferring knowledge. Regarding the design of the slides of the presentations that were observed by the interviewers at the time of applying the tools of data collection, the teachers met the minimum educational

requirements and they should have at least to capture the attention of students.

This has led to other questions that arise: If the classrooms are equipped, where is the failure, in technology, teachers or both? Have the courses been sufficiently implemented by FADU to their teachers in the integral use of this technology? Whether the teachers have been taught how to use basic way but not incorporated into the educational process efficiently? Will it affect significantly the age or profession of professors for the incorporation of ICTs in their classes?

(4) Finally, research shows that graphic design can provide a pleasant atmosphere in the treatment of the topics to handle shapes, textures, colors and graphics for didactic materials in a dynamic and interactive way, using the format of digital CD-ROM in this case. This gave students the opportunity to choose this medium of print formats, as entailing the possibility of using this material, as many times as the process itself is required, making it be reusable. The student-professor and present and/or future people can prevent the indiscriminate use of printed material that currently exists in the delivery of lectures in universities and usually at the end of a subject they become scrapped, thereby causing an increase in the production of waste and larger amount of paper.

Progress on the project has yielded a series of data that will be crucial for the proper use of "smart classrooms" on FADU, which should identify strategies to strengthen the areas that until now have reflected the obtained results.

The project itself can, through the established methodology, as well as the obtained product, generate the beginning of a series of digital didactic materials designed in an appropriate and sustainable way.

References:

Beltrán, V. & Carranza E. (2001). *Computer science and functioning of the universities*. ITESM, México. Retrieved from http://ciberhabitat.com/universidad/ui/ifu/ifua.htm.

Cabero, A. J. Y. & Márquez, F. D. (1999). *The production of multimedia materials in the university education*. Kronos, S. (Ed.). Spain.

Chaires, H. J. (2002). *Metodology for online contents design*. UAT. (Ed.). Mexico.

Ciees. (2000). *Frame of reference for the evaluation (2nd ed.)*. Architecture, Design and Town Planning Comittee. SEP, Mexico.

Domínguez, F. G. (1999). The new technologies and the continuing education. Beyond instruments or tools. Toward a new cultura of formation and its organization. *New Technologies in Flexible and Distance Formation, EDUTEC'99*, Editorial KRONOS, Seville, España.

García, I. V. Y. & Cabero, A. J. (2007). Interactive multimedia use in the university context. *Magazine, 30*. Pixel Bit, July, 1997.

García, M. A. (1999). *Interactive multimedia: Reflections around a pending revolution*. Complutense University of Madrid, Spain. Retrieved from

http://www.uned.es/ntedu/espanol/master/primero/modulos/teoria-de-la-informacion-y-comunicacion-audiovisual/multimedia-interactivo.htm.

Gispert, P. E. (1997). The technologic trend in education: The dangers of a mirage. *Magazine, 9*. Pixel Bit, June 1997. University of Paris VIII, France.

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