Towards a more meaningful web experience

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Introduction

This paper partially reports the results of an experimental evaluation that compares learning on a text intensive commercial website with an experimental website which uses graphic organizers to facilitate learning of products or services.

The paper begins with a conceptual background; it then summarises the virtual traditional interfaces. Thirdly, the characteristics of the experimental work are described in terms of the setting up the experiment and the building of instruments to evaluate control and experimental groups. Next, the design of a new site oriented to graphical organizers is presented, starting with the description of the instructional design and followed by the technical design. Compared results for the control and experimental groups are discussed; pre-test, post-test, appraisal questionnaire and platform records are analyzed. Finally, a few remarks are made as conclusions and the references are listed.

The Research Problem

One of the difficulties one faces when developing e-content is how to represent concepts and complex ideas. The traditional solution has been to develop websites that make intensive use of text. Such text is normally presented through the use of layouts to facilitate interaction with its different parts, particularly to make easy the navigation through its structure. This includes thematic indexes, hyperlinks to other parts of text, images, or other pages.

However, e-content which is intensive in text represents an important effort by the user to be internalised as knowledge. There is no doubt that such a process involves a learning cycle: a process of meaning building. This is particularly relevant for virtual environments that provide data and information intended for users that requires to take an action, for example, to make a decision about what product or service to buy.

It is not difficult to find websites that do not provide meaningful experiences for their users. The language used is usually too technical and complex; the central points tend to be lost since relevant aspects are not remarked. Thus, such websites do not provide memorably experiences since their focus are not on relevant aspects. They do not provide enough motivation as they do not pose challenges nor objectives for navigating are given. They do not provide cost-effective experiences because when seeing a specific topic, the vision of the whole is lost, usually users have to surrender memory and learning resources to grasp the site logic. The following figure includes a typical page of the sites described.

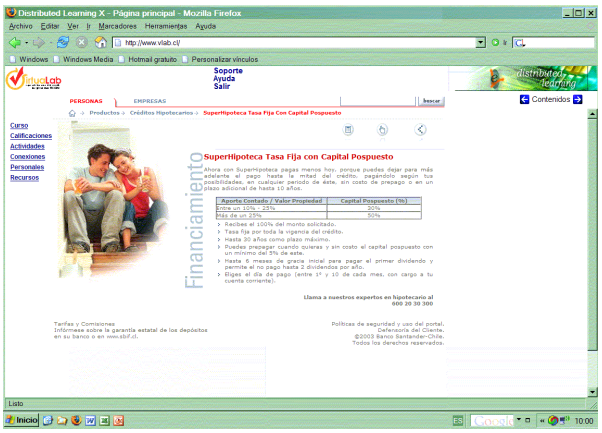


Figure 1: typical traditional page

Figure 1 demonstrates that icons are used decoratively and not to assist understanding. Text is technical and extensively used, causing early desertion. Colour follows corporative image and not user comfort. The user ends up building the information from the scattered text.

Visual Learning

Research has demonstrated that visual learning is one of the best methods to process, organise and prioritise new information (Marzano, et al., 2004). From a cognitive perspective, a good visual representation should stimulates motivation, facilitates comprehension, acquisition, retention, storage, retrieval, and transfer of knowledge (Gagné, et al., 1992).

Visual representation, as **graphic organisers**, facilitate the discovering and design of patterns, relationships, and interrelationships, as well as helping to develop creative thinking (Campbell, et al., 2001).

A graphic organiser is a combination of non-linguistic representations (shapes, symbols and arrows) with linguist elements (words and phrases). Learning through graphic organisers such as conceptual maps, flowcharts, time-sequence patterns, cause-effect diagrams, comparison matrix, among others, produces important gains in content comprehension (Marzano, et al., 2004).

Another contribution is the use of graphic organizers to structure knowledge, specifically for contents of conceptual type; the purposes of the graphic organizers are to draw student's attention to relevant material; to show up relations and to remind existing information (Gutierrez, 1987).

Consequently, given the difficulties representing concepts and complex ideas just by using text, graphic organisers emerge as an interesting solution for this problem. Thus, representation of information and content through graphic organisers can be an excellent way to help users on virtual environment, such as websites and e-learning systems, to understand such information or improve their learning experiences.

The experiment

An experiment was designed to test whether, in virtual environments, improvement in visualization, through introducing graphic organisers and visual attractiveness, improves content apprehension, as the first step on a deep learning process. Our thesis is that an adequate use of visual language to design websites facilitates meaning building processes and generates stimulating learning experiences.

The experiment was developed to compare a virtual traditional configuration, which was taken from a leading Chilean Bank's website, versus a similar configuration but designed and developed using graphic organisers.

The product chosen for this experiment was "mortgage", particularly, its associated information on the Bank's website. The main reasons were that mortgage involves a series of complex concepts, technical language, and topics related to finance, law, economics and mathematics. An examination of all Chilean Banks' websites showed that such complex ideas are explained by using text only, with some associated images for emotional effects. The role of such text is mainly promotional rather than informative, making it difficult to comprehend it.

In order to carry out the experiment, an experimental website was developed, based on the information presented on the Bank's website. Graphic organisers were used to organise and present the same information about mortgage that the chosen Bank displayed on its actual website.

The design and development of the experimental website were motivated by two perspectives: educational and technological. On the educational side, the design was based on the competence model (Román, 2005). Firstly, the module name was set: mortgage for housing. Secondly, the expected learning outcomes were generated: to describe and analyze housing purchase through mortgage. Thirdly, three competences were identified, with their respective descriptors and associated content; the latter were categorized in conceptual, procedural and attitudinal. The following table illustrates all these elements for the third competence. The column on the left includes the descriptors and the columns under contents disclose the three types of contents.

Table 1: Details of contents

Competence 3: Design and select best option for mortgage			
Descriptor	Content		
	Conceptual	Procedural	Attitudinal
Synthesis of relevant information v/s mortgage options	Mortgage characterisation and options	Model own mortgage	Responsi-bility
Understand effects of available mortgage options	Procedures and steps to obtain a mortgage	Tell and bargain needs for given offers	Prudence
Select mortgage responsibly and autono-mously	Housing offers available	Communica te decision	Judgment of rules and laws

The next stage was to select and build different types of graphic organisers to organise and present the concepts and notions associated with mortgage. For example, a differences and similarities diagram helped to illustrate the differences and similarities between mortgage with fix rate and mortgage with variable rates (widely promoted in the Chilean mortgage market).

The technological design had special consideration for the use of symbols, icons, text, colour, and screen layout. The use of icons substituted content previously displayed as text; this added attractiveness to the new site. Icons were also introduced to facilitate navigation and for faster content assimilation. Corporative colours were used, and innovations were respectful of that. Graphic organisers not only were used to organise and present information but also as a structured navigation tool.

The following figures outline two of the screen developed for this experiment.

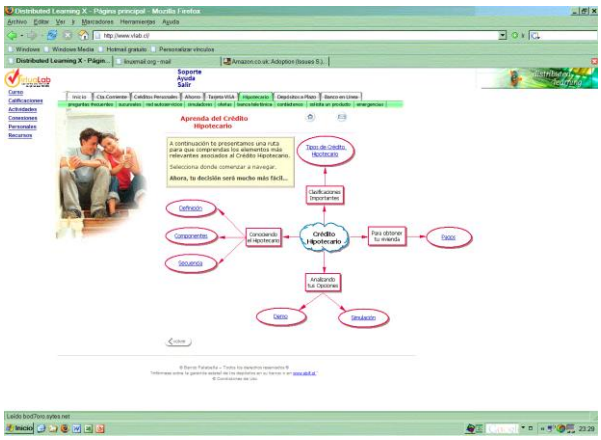


Figure 2: Main idea diagram

The text inside the ovals of the main idea diagram holds hipper links to explanatory text, other diagrams, examples or simulations.

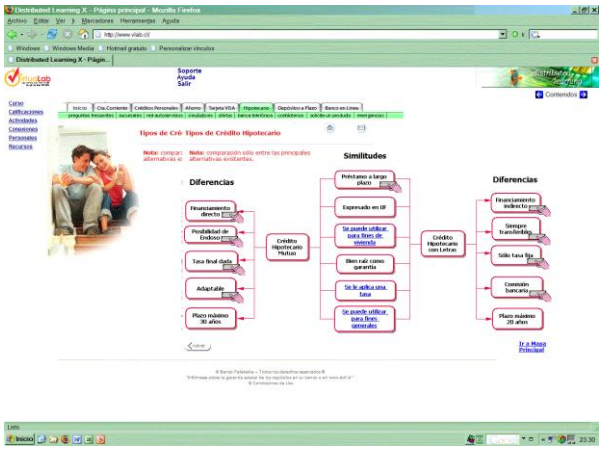


Figure 3: Differences and similarities diagram

Navigation on this screen is organized in various manners:

a) Hipper links to explanatory pages or other graphic organizer.
b) Pop ups with additional information.
c) New windows when information to be presented is more extensive.

The site designed for the experiment had 12 pages of the same sort, presenting the same information as the 15 pages of the traditional site.

Experimental design

An experimental design with control group was used for this study.

A group of 29 students from the Industrial Engineering Department at the University of Santiago were invited to participate in this experiment. They were randomly assigned to form the control and experimental groups. Due to computer lab restrictions, the control group was formed with 11 subjects and the experimental group with 18 subjects. Both groups used two different computer labs and there was no communication between the groups and among the subjects.

Variables

- Content apprehension: This is the dependent variable. It shows the capacity of the user to remember and recall basic patterns and relationships presented on content displayed on a website. In other word, this variable measures a first approximation to a meaning building process.
- Content visualisation format: This is the independent variable and it relates to the form content is presented or displayed on a website. It takes two values: (a) text intensive content and (b) graphic intensive content. In this experiment, the bank's website, which is text intensive, was used by the control group and the graphic intensive website was used by the experimental group.

Experimental Phases

First, a pre-test was designed to determine the initial level of knowledge about mortgage of the participants. This test was simultaneously administrated to the control group and experimental group.

Second, both groups were submitted to the experimental conditions. The control group navigated through the traditional configuration (text intensive) and the experimental group navigated through the graphical configuration.

Third, a post-test was designed and administrated to the control and experimental groups. Its purpose was to determine the level of content apprehension by the participants. The questions included in the post-test aimed to capture whether participants could remember basic notions, detect relationships and discriminate main characteristics associated with mortgage.

Fourth, a questionnaire regarding perceptions by participants about the virtual environment was carried out with the control and experimental groups. This was done to illuminate how contents were presented; the methodological resources, assistance level, interactivity and motivation present in both website's configurations.

Additionally, the virtual environments for both configurations kept track of the navigation carried out by the control and experimental groups, although these results are not presented in detail.

The pre-test was structured in four parts. The first part dealt with the research project and asked for cooperation. The second part gave the purpose of the questionnaire (to know the level of knowledge about getting a mortgage). The third listed seven questions of the multiple choice type. The final section was for recording internal data for processing purposes. The marking procedure for the pre-test was on scale from 0 to 100%.

The post-test purpose was to assess the knowledge acquired through the navigation of both websites. It was structured in two parts; the first had the same seven questions as the pre-test, but phrased and ordered differently; the eighth question was a true and false statement.

The questionnaire to appraise the virtual environment was divided in three sections. The first section presented the research project; the second, the purpose (to illuminate how contents were perceived). 49 statements were grouped into five categories: contents (12 statements), methodological resources (8 statements), level of assistance (8 statements), motivation (9 statements) and interactivity (12 statements). Answers were of the fixed type and structured as a Liker scale, where 1 meant total disagreement through 5 that meant total agreement.

Results

A t test for independent sample ($\alpha = .01$) was used to compare both (1) the entrance knowledge level by using the pre-test, and (2) the effects of the treatments on both the experimental and control groups by using the post-test. Random assignment of participants to the groups made t test for independent samples the appropriate test of significance. The following tables show the results:

Table 2: Entrance knowledge level

Pre-test	Group		t-distribution	p-value
	Experimental	Control		
Mean	43.5	42.4	0.155	0.877
SD	19.1	17.3		

(df= 27), ($\alpha = .01$)

Table 2 shows the results on the pre-test, which allowed to measure basic and general knowledge regarding mortgage of both experimental and control groups. The results of the pre-test indicate that both groups are equivalent for experimental purposes (p-value=0.877). It also shows that both groups have little knowledge about mortgage, where the means for both groups is below 50%.

Table 3: Knowledge level for experimental group

knowledge level	Experimental Group		t-distribution	p-value
	Pre-test	Post-test		
Mean	43.5	72.2	4.848	0.000
SD	19.1	11.4		

(df= 17), ($\alpha = .01$)

Table 3 shows that the experimental group significantly improved its level of knowledge about mortgage after navigating through the experimental bank's website (p-value=0.000).

Table 4: knowledge level for control group

knowledge level	Control Group		t-distribution	p-value
	Pre-test	Post-test		
Mean	42.4	55.3	2.191	0.053
SD	17.3	19.8		

(df= 10), ($\alpha = .01$)

Table 4 shows that the control group did not have a significant variation on the level of knowledge about mortgage after using the actual bank's website (p-value=0.053).

Therefore, it can be concluded that after the navigation through the graphical and test based Web interfaces, there was greater content apprehension by the experimental group in comparison with the control group.

Another way to appreciate the differences between the two groups is the analysis of post-test mark spread, as the following table shows:

Table 5: Marks spread on post-test

Score	Percentage of students	
	Control	Experimental
0% - 25%	27.3%	0.0%
26% - 50%	27.3%	22.2%
51% - 75%	45.4%	44.4%
76% - 100%	0.0%	33.4%
Total	100.0%	100.0%

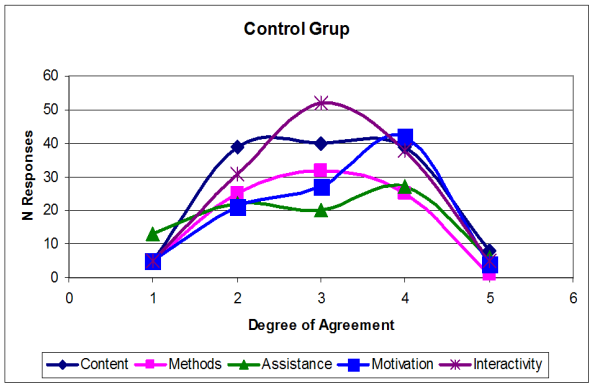
Table 5 shows that students in the experimental group had much better results than the control group, in which about a quarter was insufficient and none got very good mark. While in the experimental group, none was insufficient and nearly 80% had good or very good marks.

The other aspect evaluated was the perception by the users about both website under evaluation. The following table shows the results of performing SPPS reliability analyses (α) for each of the questionnaire categories. It shows that the instrument applied resulted to be highly reliable.

Table 6: α coefficients

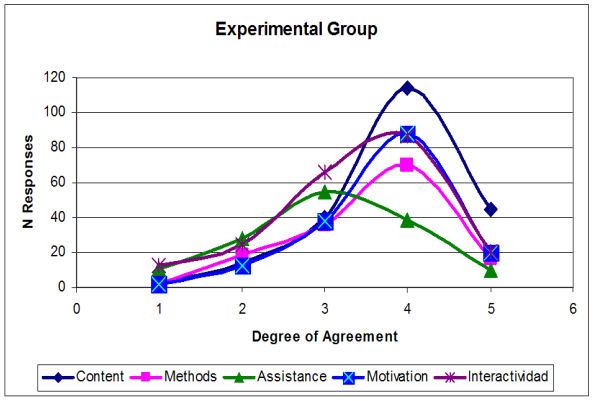
Dimension	α	%
Content	0.7936	80%
Methodological resources	0.8381	84%
Assistance level	0.8351	84%
Motivation level	0.8245	82%
Interactivity	0.7890	79%

A first level of processing consisted in grouping responses per category; thus, the following graph presents the number of responses for the control group, who navigated the traditional text oriented site.



Graph 1: Control group

Curves in graph 1, representing students' answers, clearly show that students were relatively in agreement with the five categories of characteristics of the site. Graph 2 presents the experimental group's responses.



Graph 2: Experimental group

Curves in graph 2 are clearly moved towards the right; that is, students in the experimental group had major agreement with the remarks regarding contents, methodological resources, levels of assistance and motivation and interactivity present in the site oriented to graphic organizers.

From the information saved by the virtual platform, it was possible to determine that, for the graphic organizer site, 61% of students started navigation accessing the diagram with definitions, 33% preferred to start visiting the types of mortgage available, the remaining 6% had a preference to start with an example.

Conclusions

The pre-test or diagnosis evaluation and the post-test or formative evaluation showed that the experimental group had a better level of appropriation of contents.

The Web interface configuration intensive in graphic organizers improved not only learning but also student valuing/perception.

The navigation analysis showed that the design principles used functioned as expected for the experimental group, in particular the visual spatial principles, thus improving ubiquity, synthesis and learning styles.

Finally, it is revealed that graphic organizers are useful as means for presenting contents of the conceptual type and have potential for contents of the procedural and attitudinal types.

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