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Information or Education? A proposal for web education

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Introduction

The general purpose of the empirical part of the research work presented below developed out of the idea of how to best design educational web pages in order to stimulate a meaningful learning process for the user.

The effect on learning of certain types of pedagogical assistance incorporated into web pages has been examined, with a focus on verifying whether this assistance, and which types in particular, is appropriate for meaningful, individualised learning in order for learners to be able to test, divide up, construct, develop and regulate the learning process themselves. The educational web page model described below is a proposal for the project pilot, the purpose of which is to assess the effectiveness of pedagogical assistance and the effect that this has on learning acquisition.

General objectives and research design

The focus of this pilot study is to design and prepare a web page that is educational and to analyse the influence of instructional design using pedagogical assistance in the learning of a specific content matter, in this case the author Mario Benedetti.

The objectives are as follows:

- To prepare and assess a web page on the basis of the psychopedagogical model of instructional design, with specific content matter (the author Mario Benedetti).
- To analyse differences and similarities in the degree of knowledge acquired by a group of subjects depending on the pedagogical assistance received (declaratory assistance, inferential assistance and metacognitive assistance).
- To describe the cognitive processes of the subjects while they navigate on the World Wide Web.
- To compare and analyse differences and similarities in the mental representations of the differential features of the web page reproduced by the subjects.

Research design

1. Hypothesis

- Subject group A, in which the participants receive declaratory pedagogical assistance, will score the highest in the items that value declaratory knowledge in the final questionnaire. Browsing the web page follows a lineal structure. The time taken will be shorter than group B and longer than groups C and D. The subjects make no transfer of cognitive skills from other environments.

- Subject group B, in which the participants receive inferential pedagogical assistance, will score the highest in the items with an inferential content in the questionnaire although their declaratory knowledge will be higher in the final questionnaire. Browsing the web does not follow a lineal structure. The time taken will be longer than that of the other groups. The mental representation of the information will be more comprehensive than groups A and D and less comprehensive than group C. The subjects transfer cognitive skills from other environments. Subject group C, which receives metacognitive pedagogical assistance, will increase its score in the three types of item in the final questionnaire. Navigating the web does not follow a lineal structure. The time taken will be shorter than that of other subjects. The mental representation of the information will be comprehensive. The subjects transfer cognitive skills from other environments.
- Subject group D, which serves as a control group and receives no type of pedagogical assistance, will score the lowest for all types of question in the final questionnaire. Navigating the web does not follow a lineal structure. The time taken will be longer than that of other subjects. The mental representation of information is fragmented.

2. Variables

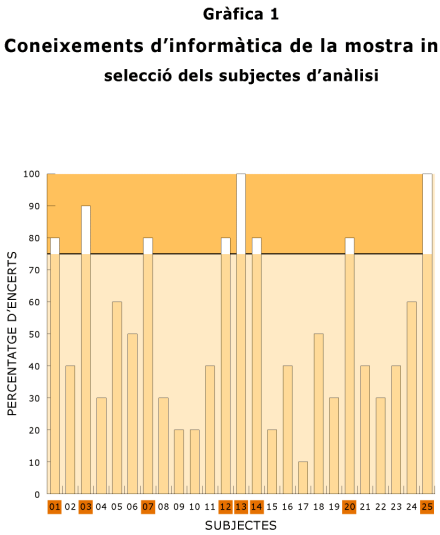
Dependent variables	**Independent variables**
▪ Declaratory learning, conceptual learning and conditional or strategic learning. ▪ Mental representation of the web page content web. ▪ Knowledge transference. ▪ Decision-making in web page navigation.	▪ Declaratory assistance ▪ Inferential assistance ▪ Metacognitive assistance
Controlled variables	
▪ The content and structure of this web page remains the same. One kind or another of assistance is introduced in the web page. ▪ All subjects used the same computer equipment to take the test: Power Macintosh G3 computer, 300Mhz, 4/192 with Netscape as the web browser. ▪ All subjects passed through every node making up the web page. ▪ All subjects started with an 80%+ knowledge of computer skills in the initial assessment questionnaire. ▪ All subjects are new to the specific content material of the web page (Mario Benedetti) ▪ The maximum period of time for browsing the web page is two hours. ▪ All subjects are obliged to reply in writing to all assistants appearing on the web page except for the control group, which receives no assistance.	

3. Sample

The initial study sample of twenty five subjects is selected on the basis of the following criteria:

- Similar academic level: university graduate level.
- Age between 25 and 35 years.
- New to the specific content of the web page.

A second sample selection is made according to expertise with computers. In order to assess prior knowledge of computers, the twenty five subjects are given a questionnaire on their declaratory knowledge of computers and a small assignment is given to assess their procedural knowledge. A final selection of 8 people is made on the basis of their scoring over 80% in the items of the questionnaire, as shown in the following diagram:



Translator's note:

Graphic 1: Computing knowledge in the initial sample. Subjects of analysis selection.

Right answers percentage

Subjects

The definitive sample for the study is made up of eight subjects; these eight subjects are distributed according to the following working groups:

GROUPS	SUBJECTS INITIAL SAMPLE	AGE	SEX	CITY/ TOWN	STUDIES	TYPE OF PEDAGOGICAL ASSISTANCE
A	S1	29	D	Mataró	Business studies	**DECLARATORY ASSISTANCE**
	S3	27	D	Granollers	Psycopedagogy	
B	S7	29	H	Granollers	Art	**INFERENTIAL ASSISTANCE**
	S12	26	H	Cardedeu	Engineering	
C	S13	32	H	Barcelona	Sociology	**METACOGNITIVE ASSISTANCE**
	S14	30	H	Barcelona	Economics	
D Control group	S20	28	D	Barcelona	Pedagogy	**NO ASSISTANCE**
	S25	29	D	Granollers	Psychology	

This sample is divided up into 4 subgroups with two subjects in each according to the independent variables introduced, which are determined by the different types of pedagogical assistance entered in the web page design.

4. Procedure and design

Whether the objectives proposed by this research and the use of different variables are fulfilled depends to a great extent on the procedure followed, the three stages of which are summarised in the following table:

STAGES AND PROCEDURE
STAGE 1
▪ Creating the Mario Benedetti web page according to psychopedagogical criteria ▪ Preparing the pedagogical assistance to be included in web pages 1, 2 and 3. Web page 4 has no assistance.
STAGE 2
▪ Preparing the research. ▪ Adapting the data collection instruments. ▪ Selecting the sample from the first questionnaires.
STAGE 3
▪ Implementation (web page navigation + assessment)

This research work has been carried out with eight subjects as described in the sample above. The sample was divided into 4 sub-groups with two subjects in each according to independent variables introduced, which are determined by the different types of pedagogical assistance entered in the web page design.

GROUP		**GENERIC WEB PAGE**			
		WEB PAGE 1 WITH DECLARATORY QUESTIONS	**WEB PAGE 2 WITH INFERENTIAL QUESTIONS**	**WEB 3 PAGE WITH METACOGNITIVE QUESTIONS**	**WEB PAGE 4 SENSE PREGUNTES**
A	**SUBJECT 1**	**X**			
	SUBJECT 2				
B	**SUBJECT 3**		**X**		
	SUBJECT 4				
C	**SUBJECT 5**			**X**	
	SUBJECT 6				
D	**SUBJECT 7**				**X**
	SUBJECT 8				

All of the groups with different experimental conditions (web page with declaratory assistance, with inferential assistance and with metacognitive assistance) were presented with general instructions informing that they have two hours to browse the web page, that they will receive pedagogical assistance in the form of questions to be answered and that they will be assisted in acquiring and constructing knowledge on Mario Benedetti. One other condition of the assignment is that they have to refer to the entire sequence of pages.

The instructions also explain that there is a second part to the test that consists of a final questionnaire on the specific content (on Mario Benedetti), which they will have to complete without referring to the web page and some other assignments on the process that they have

followed when browsing the web page and the mental representation of this that they have created.

Following these general instructions, the test begins with what is termed the navigation stage. The navigation stage begins when the different groups open the web page with its corresponding pedagogical assistant according to the independent variable of each group.

Once the time limit for the navigation stage has expired, the assessment stage begins with the different questionnaires that are the same for all of the groups in experimental conditions. The order and way in which the questionnaires are handed out is as follows. A computer programme is used and the navigation route entered. They then disconnect from the web page and they are given the questionnaire to assess their knowledge at the end. They are subsequently asked to make a graphic representation of the mental map that they have constructed of the web page and they are then given an assignment to transfer the cognitive skills to another web page.

A summary of this procedure is given in the following table:

NAVIGATION STAGE	Navigation through the entire information network of the web page. The navigation route is recorded.
ASSESSMENT STAGE	Questionnaire on Mario Benedetti
	Assignment to mental represent the content.
	Assignment: transfer knowledge to another environment

5. Materials

5.1 The web page

The Mario Benedetti web page has been created for three fundamental reasons:

- It is a web page that deals exclusively with the subject of Mario Benedetti. This content was selected because it is an area of general interest and by following the criterion of an unknown environment. None of the subjects in the study knew of the web page nor had visited it previously.

- To control all of the variables that make the multimedia environment more instructional.

- The web page itself has grown into four. The independent variables of different forms of assistance have been entered into each one with one web site with no variables that serves as a control.

5.2 Observation and recording

The subjects are observed while browsing the web site at the same time that a recording is made of the verbalisations that they make whilst working on the assignment. Any relevant incidents or facts are noted on a record sheet for subsequent analysis.

The navigation route of each subject is recorded by the computer programme. This records the itinerary followed by the subject and also gives the time spent on each navigation movement.

5.3 Questionnaire

- Knowledge of computers. This questionnaire is used to select the sample. The questionnaire consists of 10 items, which have been validated by a computer expert and designed according to the different types of declaratory, procedural and strategic knowledge.
- Knowledge of Mario Benedetti. This questionnaire is handed to the sample subjects in order to assess their degree of declaratory, procedural and conditional or strategic knowledge before and after browsing the web page. These items have been designed according to the different types of knowledge and validated by an expert on Mario Benedetti, so that there are 6 items for each of the three types of knowledge being assessed.

5.4 Assignment

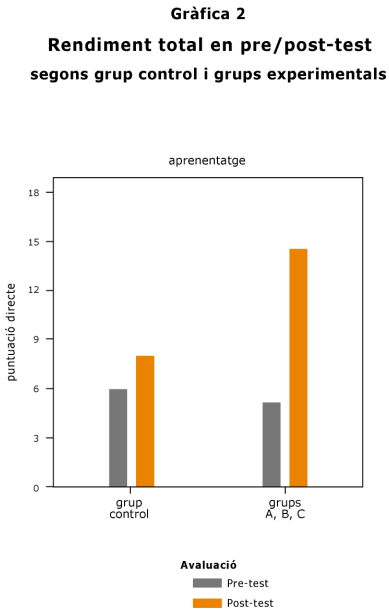
- Assignment to graphically represent the mental layout of the contents of the web page. The subjects are asked to graphically describe the mental image that they have of the structure of the web page contents.
- Assignment to transfer cognitive skills. The subjects are asked to browse another web page and to verbalise the process that they have followed in answering the question: What does the web site contain? And the reasons why the particular work procedure was used.

Analysis and description of the results

When describing and interpreting the data, a distinction is made between each different result extracted from the analysis. Comments on the educational implications of these are made in a final section with a summary and conclusions.

1. Description of the data extracted from the questionnaire

- *Learning the contents of the web site without entering any variable versus learning acquired by introducing independent variables (declaratory, inferential and metacognitive assistance).*



Translator's note:

Graphic 2: Global performance in pre / post test in control group and experimental group.

Learning

Direct Scoring

Evaluation.

It can be seen from graph 2 how the groups that have worked with assistance have a higher score than the control group which remains with no condition. From this it can be affirmed that the pedagogical assistance experimental variable shows an increasing effect on the learning of the specific contents.

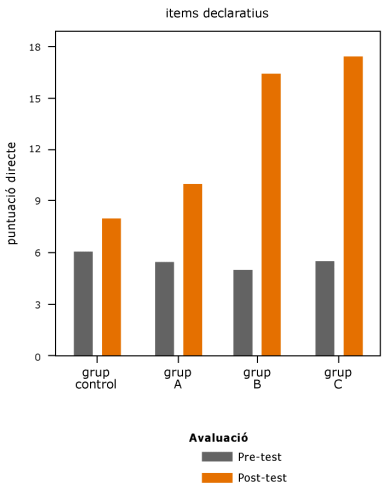
- *Learning content of the web without introducing independent variables versus learning in different experimental conditions*

Control group
Group A: web page with declaratory assistance
Group B: web page with inferential assistance
Group C: web page with metacognitive assistance

Gràfica 3

Rendiment total en pre/post-test

per a cada grup experimental



Translator's note:

Global performance in pre/ port test in each experimental group.

Declarative items.

Direct scoring.

Evaluation.

It can been from graph 3 that a change in the degree of learning also occurs, not only if the web page includes assistance or not but also in relation with each form of assistance entered separately in each group.

From this, it can be stated that the independent variable has different implications according to the type of variable entered for each group. There is a difference not only in whether there is pedagogical assistance or not but also each type of assistance enhances the increase in learning to a different degree.

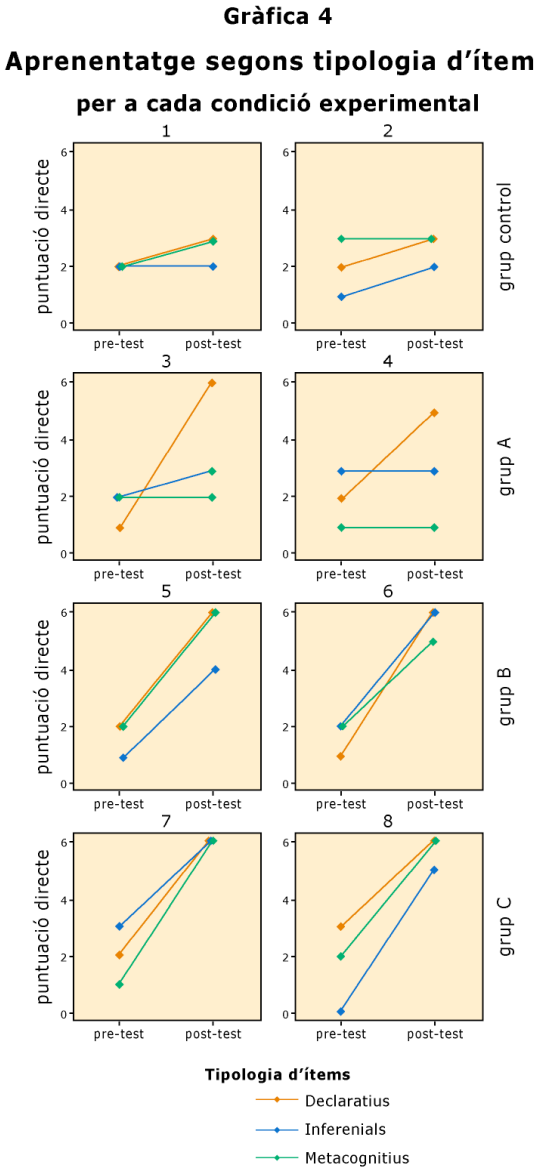
From a comparison of the degree of learning of the different groups (group A, Group B, group C and Group D), the performance of the different groups shows that there are important differences in the performance of learning the web page content, as is shown in the graph.

Groups B and C had a much higher level of learning than groups A and D for all types of knowledge (declaratory, procedural and conditional)

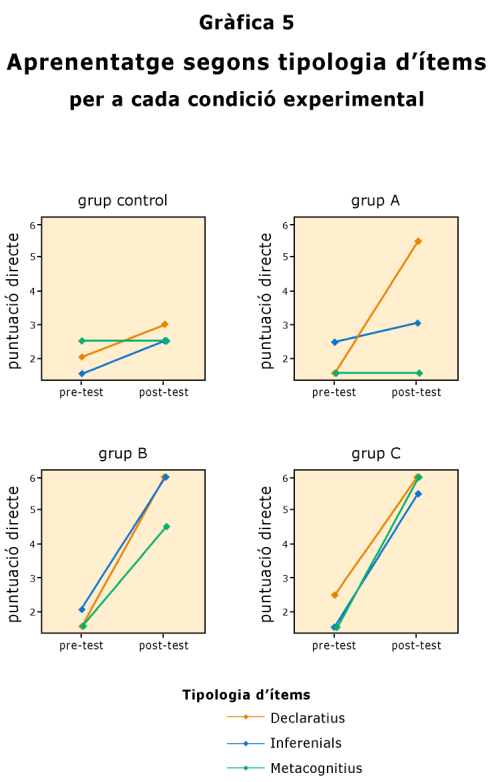
- *Learning according to item type for each variable introduced.*

Control group
Group A: Experimental conditions: declaratory assistance
Group B: Experimental conditions: inferential assistance
Group C: Experimental conditions: metacognitive assistance

Gràfica 4



Gràfica 5



Translator's note:

Graphic 4 & Graphic 5: Learning by item's typology in each experimental condition.

Item's typology:

Declarative.

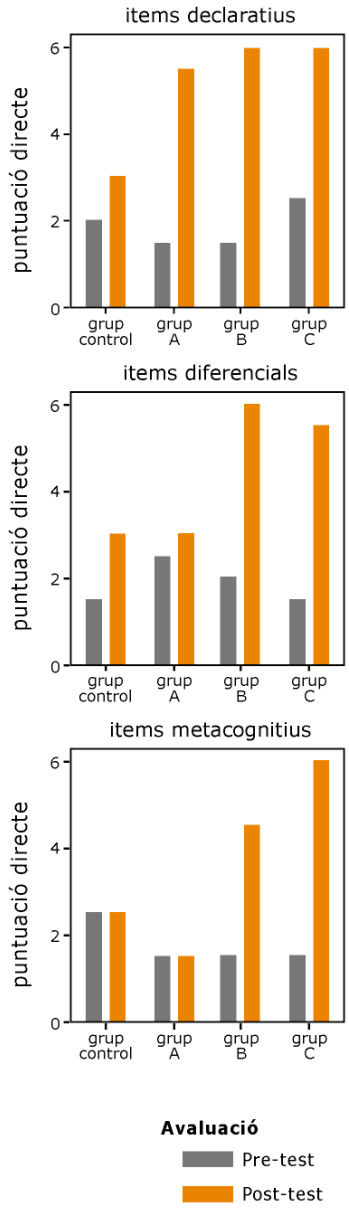
Inferential.

Meta-cognitive.

Gràfica 6

Aprenentatge de cada grup experimental

per a cada tipus d'ítem



Translators note:

Graphic 6: Learning in each experimental group by each item type.

Declarative items.

Inferential items.

Meta-cognitive items.

Direct Scoring.

It can be seen from these graphs how the type of assistance received by the user directly correlates as the user's score increases in response to the type of related item. In other words, there has been an important increase in learning in group A, which received declaratory

assistance, in this type of knowledge as opposed to the two other types of procedural and conditional knowledge.

In groups B and C (that received inferential and metacognitive assistance respectively), there was a higher rate of learning not just in the type of related knowledge (procedural and conditional knowledge respectively) but also of learning in the three types of knowledge. There was very little difference between group B (inferential) and group C (metacognitive).

Learning in each group that received assistance for each type of knowledge.

- Declaratory knowledge

With regard to the answers in the items that assess declaratory knowledge, there were no relevant differences between the three groups that received assistance. Declaratory, inferential and metacognitive assistance all improve declaratory learning in the user.

- Procedural knowledge

With regard to the answers in the items that assess inferential knowledge, there were important differences between the group that received declaratory assistance and the groups that received inferential or metacognitive assistance. The latter acquired more procedural knowledge.

There were no important differences in the acquisition of procedural knowledge between the group that received inferential assistance and the group that received metacognitive assistance.

- Conditional or strategic knowledge

With regard to the answers in the items that assess conditional knowledge, there were relevant differences between the group that received declaratory assistance and the remaining groups (the group with inferential assistance and the group with metacognitive assistance). The latter two showed a higher performance in answering the items of conditional and strategic knowledge in the questionnaire.

Differences were observed between the control group and group A, with the control group acquiring more conditional or strategic knowledge than the group that received declaratory assistance.

2. Description of the results: graphic representation of the mental outline of the web page content.

2.1 Control group and Group A: Declaratory assistance

The main characteristics of the four subjects in the control group and group A when representing the content of the Mario Benedetti web page were based on declaratory knowledge, that is, they only explained the basic structure in a linear way: country-works-life.

They did not establish circular relationships nor did they show any holistic or procedural view of the contents.

2.2 Group B: Inferential assistance

The main characteristics of the two subjects in group B when representing the content of the Mario Benedetti web page were based on procedural knowledge, that is, they explained the declaratory content by relating the main concepts.

They established circular relationships and showed a more holistic and procedural view of the contents than the previous groups.

2.3 Group C: Metacognitive assistance

The main characteristics of the two subjects in group C when representing the content of the Mario Benedetti web page were based on a radial way of making a conceptual map, that is, they linked each block of declaratory knowledge on the basis of the basic structure with the other contents. They established circular relationships and showed a more holistic and procedural view of the contents compared to group B (inferential assistance).

3. Description of the results: Assignment to transfer cognitive skills

Low level of cognitive skill transfer:

- Control group and group A: declaratory assistance: They did not spend time in planning or deciding how to best achieve the goal. They went from one page to another in less than 10 seconds, and this only increased at certain times. They started with no prior plan to guide the assignment or the decision-making process. No pre-established order for the navigation route was followed and they just went from one place to another on the basis of trial and error. They did not question the process being followed nor the content selection. They verbalised comments like:

  Subject 3: "... Here it says lecturers while here it says researchers..."
  Subject 1: "... All together there are...let's see, one, two, ...six sections".

Cognitive skill transfer:

- Group B: inferential assistance: Their actions adapted to the goal of the assignment, they made decisions such as "...I'll only read the headings..." They tried to relate the headings of each section, they asked why there was one piece of information and not another. No pre-established order for the navigation route was followed and they went instead from one place to another according to their decision-making process. No question was made of the process being followed nor the content selection.

- Group C (Metacognitive assistance): They spent a long time looking at the home page and verbalised actions such as: "...hold on, I'm just checking the route I'm going to take..." "...let's see if this also has an outline with all the information?..." Their actions adapted perfectly to the assignment objective. They regulated the assignment process "...hey, is that all I have to do, answer what it's about?". They attempted to relate the nodes of each. A pre-established order for the navigation route was followed.

4. Description of browsing the Mario Benedetti web page

All of the groups (the control group and the experimental groups) browsed in a linear order. They started from an information node and then sequentially followed the different nodes that they found in the index.

The subjects in group B (inferential assistance) came back at certain times to the information nodes that they had already visited in order to answer the questions with information required.

The subjects in group C (metacognitive assistance) followed a linear order although, on having passed through all of the content nodes, they came back to certain specific nodes.

The time spent by each subject group fluctuated approximately between eighty minutes and two hours exactly. The control group spent the least amount of time browsing; group C spent approximately twenty minutes longer on browsing and groups A and B spent approximately forty minutes longer.

	CONTROL GROUP	GROUP A	GROUP B	GROUP C
Total	**84 minutes**	**111 minutes**	**117 minutes**	**99 minutes**
Movements	**115**	**93**	**134**	**119**

General conclusions

This brings the field work and the empirical analysis stage to an end. Below are the conclusions of several of the main results, together with a series of open questions for further research. The focus has been to identify the most significant aspects of the way in which the subjects under study went about the assignment they were given.

1. Comparison with the hypotheses

- Decision-making and browsing were significantly different amongst the subjects according to the differential features of the assistant appearing in each web page

The first hypothesis was not confirmed as expected. Instructions were given to the user prior to navigating (you have to go through the entire sequence of pages) which made the subjects follow a linear order in order to know at all times how far they had got.
Inferential assistance led to users breaking away from this linear order of action, however, making them go to other non-sequential links in order to answer the relationship questions. It can thus be said that inferential questions led the subjects to navigate in a resourceful, circular way.

- The mental outline of the web page structure made by each subject will be significantly different according to the differential features of assistance appearing on each page. Subject group B (inferential assistance) will make use of procedural knowledge to graphically represent the web page structure. Subject groups A (declaratory assistance) and D (no assistance) will make use of declaratory knowledge to graphically represent the web page structure. Subject group C (metacognitive assistance) will make use of conditional or strategic knowledge to graphically represent the web page structure.

The results obtained in this research confirms this hypothesis.It can be seen how instructional design that encourages the learning of declaratory knowledge makes the user-learner rely on this declaratory knowledge, leading to learning that is more conceptual than procedural.

The fact that instructional design that encourages the learning of procedural knowledge makes the user-learner rely on declaratory content that is interrelated is also confirmed. This type of learning confirms that the learner user establishes circular relationships and they are shown to have a holistic and procedural view of the content.
The introduction of metacognitive assistance in a web page encourages the learner user to outline his/her own description of the content to the point of incorporating and understanding it.

- Subject group A (pedagogical declaratory assistance) will score highest in the questions with a declaratory content in the final questionnaire. The time taken will be shorter than that of

group B and longer than that of groups C and D. The subjects make no transfer of cognitive skills from other environments.

The results confirm the hypothesis. The group receiving declaratory assistance has a higher performance with this type of question compared to its performance with questions that require a process of establishing relationships and reflection.
However, there is no notable difference amongst the three groups when comparing declaratory learning; the use of inferential and metacognitive assistance is therefore more encouraging for stimulating learning from three points of view and not just in declaratory knowledge.

Despite the fact that it was anticipated that subjects who received declaratory assistance would be more concise in reading the information in order to correctly answer the short questions put to them and that this would slow down their navigation process, it was found that subjects often opened the assistant and searched the answer to the question, thus avoiding any other declaratory content.

- Subject group B (inferential pedagogical assistance) will score highest in the questions with procedural content at the same time that its declaratory knowledge will increase in the final questionnaire. Browsing of the web page will not follow a linear structure. The time taken will be longer than that of other subjects. The mental representation of the information will be more comprehensive than that of group A and D and less comprehensive than group C. The subjects transfer cognitive skills from other environments.

The first part of the hypothesis is confirmed. The subjects receiving inferential assistance to learn showed a very high performance on answering questions related to this. Declaratory knowledge also increased, which is basic for establishing relationships.
The hypothesis was put forward that the answering of inferential questions, which would lead to the construction of significance, would slow down the learning process. It was subsequently shown that these subjects in fact spent the longest time navigating.

- Subject group C (pedagogical metacognitive assistance) will increase its score for the three types of question in the final questionnaire. Browsing the web page will not follow a linear structure. The time taken will be shorter than that of other subjects. The mental representation of the information will be comprehensive. The subjects transfer cognitive skills from other environments.

From the results analysed, it was confirmed that the subject group receiving metacognitive assistance scored very highly in the acquisition of the three types of knowledge. Nevertheless, there was no important difference from the group receiving inferential assistance.

The way these subjects browsed, however, was different in an important way in relation to the other groups. Once they had entered the section of the page navigation map, which includes its entire content, they went over it at different times to get to grips with and regulate the navigation process. It is to be expected that this element would lead them, in the representation of the information, to represent the content in an interlinked way and arrange the information in order of importance, as well as to add their own contributions to this representation.

- Subject group D, which was the control group (without any type of pedagogical assistance) will have the lowest score in all types of questions in the final questionnaire. Web page navigation will not follow a linear structure. The time taken will be longer than that of other subjects. The mental representation of the information will be broken up.

While it did have a lower score at the declaratory level in comparison with the other three groups, this final hypothesis is not confirmed due to the fact that this was not so in the case of inferential and metacognitive knowledge.

As regards inferential knowledge, it acquired the same as the declaratory group and as for conditional knowledge, it acquired more knowledge than the declaratory group. It can therefore be stated that it is more effective to not just put declaratory assistance if the aim is for users to acquire conditional knowledge. Neither was the fact of predicting who would take the longest to complete the assignment confirmed because it was group B (inferential) that took the longest. The supposition was that, without a guide to question, browsing would be more disordered and the process of navigation slowed down.

Particular interest was given to the analysis of knowledge transfer in this study and the fact of not overlooking its importance. The introduction of inferential and metacognitive assistance in a hypertext environment, as the results show, are necessary conditions for transfer to occur. These two types of assistance led to conscious abstraction in the subjects. One element that should thus never be neglected when creating educational web pages is to include instructional design that influences pedagogical assistance in an inferential and metacognitive way.

2. Educational implications

One initial idea that stands out is that these hypermedia systems are an excellent tool for accessing information that offers certain advantages in learning and education. Information can be organised and disorganised in an unlimited way, it has a very high interactive capacity, it permits home schooling and it enables users to build and work on their own knowledge. These systems are still not fully developed, however. Their theoretical foundations are still not totally clear, there is no coherent theory on hypertext to provide for valid criteria for designing this type of hypertext document. The purpose of this research has been precisely to work in this area and it can be stated that the use of some kind of metacognitive pedagogical medium or assistance that increases conditional knowledge does lead to increased learning.

Web pages do not improve learning on their owns whereas progress in learning is the responsibility of the mediator. The learner needs to be mediatised by the very processes of thought and that this be put into practice in assignments where strategies can be applied. Accordingly, before providing learners with the technological means, they need to be taught how to think and what cognitive processes to use in order to be more efficient. The incorporation in web pages, which up until now have been more informative than educational, of elements that stimulate this way of thinking will greatly enhance the learning process and make the purpose of instructional web pages much more effective.

Nevertheless, one should not overlook the ease with which the user-learner can get lost in this hypertext space and the resulting cognitive conflict that this can produce. Web pages thus need to find the way to respond to this conflict in order for the learner to be able to regulate his/her process. Emphasis is put on the fact that the use of such pedagogical assistance incorporated into a web page is a good tool for stimulating the thought process. Furthermore, some webs pages already include navigation maps, such as the one inserted; these maps point to a way of solving this question, with the framework of reference for these users being more on learning in hypertext environments. By following different diverse itineraries to reach the desired information, hypertext stimulates a decision-making process that needs to be conscious and intentional. If users do not enter this process on their own, then they need to be encouraged somehow to do so and to gradually acquire the knowledge that will help them to select the most appropriate itinerary in keeping with their objective. By using navigation maps and the proposed introduction of a metacognitive assistant, users always know where they are, where they have come from and where they are going, all of which are essential conditions to be born in mind for good decision making during the processes of information research and knowledge acquisition.

The role of new technologies needs to be directed towards providing and encouraging thought processes and the use of cognitive and metacognitive learning strategies. Learners will then be capable of planning and regulating their processes for researching information to resolve any type of assignment, as to just specific ones.

The design of educational hypertext systems must be carried out by somebody who is an expert in both the subject and also in terms of the psychopedagogical design. As is often the case in the theoretical aspect, the production of these systems is left in the hands of computer experts who have little idea of their pedagogical foundation.

Coming back to the idea, if a web page is designed by an expert on the matter, then the structuring of the contents of the page will respond to his/her mental structures of the subject, which will make it possible to offer users a model that reflects the mind of the expert.

Hypertext systems, as is shown here, require a high degree of reading. It is therefore useful to bear in mind when designing large hypermedia documents what prior knowledge users have when starting out. This will not only influence the way that users integrate the information but also the content selected with hypertext and the way in which the information is handled by learners.

The reading of hypertext can be described as a cycle that includes a recurrent assessment of the need for information, a selection of categories of appropriate information and the processing of selected contents.

The handling of this cycle is not easy because it requires certain self-regulating strategies on the part of the learner. If users browsing through web pages have not acquired these strategies, they need to be stimulated and encouraged to acquire them and the only way to encourage this is directly and in an explicit way.

It can be seen from the study how metacognitive assistance encourages the acquisition of these strategies as well as stimulating the transfer from other hypertext environments. The subjects of the study who received declaratory assistance expected to find linear and sequential information on the matter and it took them time to regulate the research process when they found that this was not the case. On the other hand, the subjects provided with metacognitive assistance were able to anticipate the fact that the information would be least likely to be organised in a linear order. Being able to anticipate this helped them to gain a more precise idea of how the information could be structured and how to make knowledge acquisition easier.

It was only these subjects who gained a general overview of everything whereas the others ended up with a fragmented picture of the structure of the web page. The subjects that received declaratory assistance were clear on the concepts but they did not know how to link them together while subjects that received inferential assistance found it easier to imagine how these links would be.

When designing hypertext, one must understand and take account of the characteristics of the people who it is being directed at, their goals, the strategies that they use, etc. This means that it is no guarantee that new information systems will be good for learners just by increasing storage capacity, processing speed and the complexity of research tools. Educational web pages enable information to be represented using many types of symbolic language, a fact that should be used by authors to access the user's cognitive preferences by integrating the wide variety of these symbolic systems into hypertext itself; the choice of one system of information representation or another is an interesting variable to bear in mind in the interaction between the user and the machine. What really matters, however, is the compatibility between the characteristics of the system and the learner's needs, abilities and preferences.

With the growing increase in information provided by these new technologies and access to the Internet network, it is becoming increasingly essential to provide users of these new technologies with tools to be able to critically organise this information, which in itself will determine a model of understanding.

This approach should be governed by certain general principles:

- Learners need to be taught how to form their own model of understanding in which they can identify their mistakes and skills to be able to reduce the difference between what the learner is and what he/she wants to become. This means helping them to construct their own cognitive identity.
- Learners need to be taught to reflect on their individual process of understanding and to analyse the decision-making process when carrying out an activity, which will lead to improved regulation of their cognitive processes.
- Learners need to be taught to maintain an internal dialogue when learning contents (declaratory, procedural) so that they can reproduce the new content with their prior mental patterns of understanding and in such a way that a significant level of learning can take place.

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