Hypergraphics for history teaching - Barriers for causal reasoning about history accounts

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ABSTRACT
This paper investigates the uses of various kinds of hypermedia format for history learning, which specifically emphasizes on the role of causal reasoning about history accounts. Three different groups in the last school year of Secondary Education (aged 16) studied the same materials about the Discovery of America in three different formats: (a) linear text in paper, (b) conventional hypertext with a content structure in network, and (c) hypergraphic with an explicitly causal structure and guiding questions inserted in the causal connections. The results in this last group were better in almost every causal reasoning task, but no statistically significant differences were obtained. The design of graphic information and specific interrogations for causal reasoning in a hypergraphic format could exert some positive effects. However, this type of resources is not enough to succeed in implying students with little previous knowledge in self-explanation and review processes of their causal models about history accounts.

Keywords
Computer assisted learning, Cognition and technology, Hypergraphic, Causal reasoning, History education, Secondary education.

Introduction
Research has shown that we can obtain benefits from working with multiple texts (Jacott, López & Carretero, 1998; Perfetti, Britt & Georgi, 1995; Voss, Carretero, Kennet & Siflies, 1994). Such concurrent use of diverse sources of information allows students to replicate the working methods of expert historians and social scientists as they move from data collection to ordering, categorizing and interpreting the information at hand (Carretero & Limón, 1993). What makes History memorable and coherent is its understanding through the elaboration of temporal and causal connections between the events (Perfetti, Britt & Georgi, 1995). However, the elaboration of causal explanations from different texts constitutes a very complex task demanding a strategic behaviour too exigent for most of the pupils (Rouet, Marron, Perfetti & Favart, 1998). Due to this reason, some studies have also explored the use of hypertext as a medium to make easier a more effective information management, linking multiple documents. Cognitive Flexibility Theory offers studied the kinds of navigational tools and linkages that can support effective student learning from hypermedia materials (Jacobson & Spiro,1995; Jacobson, Maouri, Mishra & Kola, 1996; Spiro & Jehng,1990; Spiro, Feltovich, Jacobson & Coulson, 1991). Nevertheless, several studies have not found clear differences between hypertext and linear texts, regarding comprehension measures. Apparently, learning materials, which are frequently offered in hypertextual format, do not seem to make users modify in a real way their linear reading strategies. On the contrary, a hypertext reading involves new threats for expositive content comprehension, mainly due to the important cognitive load it demands from the readers. They must remember the exact location of every new piece of information in the links and nodes jungle, take decisions about where they should go and remember previously visited pages or links, what usually causes a feeling of disorientation (León, 1998; Plowman et al., 1999).

As either the content or task complexity increases the student’s ability to navigate the hypertext declines. In the specific field of History teaching, diverse research pathways have found that hypermedia systems provide very limited benefits to users, conditioned, to a large extent, by students browsing conducts (Shapiro, 1998) or the assessment task type (Britt, Rouet & Perfetti, 1996). Conclusions in these works agree in the necessity of using a design model reflecting the organization top-level structure of the documents between themselves, as a favouring factor of hypertext “usability” and effectiveness.

Some works which have analysed those features that make more comprehensible causal texts in Social Sciences agree in highlighting three elements. Firstly, the events should be related between themselves following a temporal order by means of an explicit organization. Secondly, the materials should clarify the characters or human groups’
intentions involved in the historical events. Finally, information about the causal connection between two events, especially when these are distant in the text, should be provided (Linderholm et al., 2000).

Therefore, in addition to user’s hypertextual browsing experience, the aids insertion to organize and ensure the coherence in the causal explanations of historical events, could constitute an effective medium to prevent disorientation and improve the didactic utility of hypertextual information (Rouet, Levonen, Dillon & Spiro, 1996). In principle, there are two resources that could perform effectively these functions in hypertextual materials:

- the information arrangement by means of graphics reflecting the content causal structure
- interactive aids, in order to orientate the searching of information and causal reasoning processes.

**Causal Organization**

Hypermedia technology allows to organize comfortably information into non-linear typology structures that, in contrast to traditional text, emphasize the most relevant relationships between each segment. The most widely studied typologies have been the network and hierarchical structures (De Vries & De Jong, 1999). Against what some technologists seem to assume, there are no clear evidences proving that these ways of arranging information are really advantageous for the learning of most of the students.

Network formats, commonly used, in which the user can navigate through different documents do not facilitate learning (Mohageg’s, 1992; Simpson & McKnight, 1990). They can even produce worse results than traditional and linear versions (McDonald & Stevenson, 1996).

Unlike network typologies, the hierarchical ones are usually organized around graphics or tables to make easier users’ orientation (Kommers & Lanzing, 1998). A hypergraphic is the graphics counterpart of hypertext: a linkage between related information by means of a graphic image. Instead of clicking on a word, users click on an icon to jump to the related information.

A meta-analysis carried out by Chen & Rada (1996) about 23 experimental studies with hypermedia materials came to the conclusion that the graphics presence helping to visualize the structure of information contributed significantly to achieve a greater utility of such systems. However, other studies have found that the advantages of hierarchical or mixed typologies are only really significant with students with a good reading capability but small previous knowledge of the content (Calisir & Zurel, 2003).

The possibilities for hypermedia materials are not reduced to the above mentioned typologies. In the case of History for example, the representation of a historical phenomenon is not necessarily hierarchical, neither must be distributed as an associative net. It should also reflect the causal connections between the distinct events and conditions of the historical moment studied. As we have already explained, the teaching material should provide an explicit arrangement of those events related between themselves, following a temporal and causal order.

**Inferential implication resources**

A hypertext reading demands a great inferential effort to maintain information coherence (Stanton, Correia & Dias, 2000). In the case of History learning, the necessary inferences can be of a distinct type and complexity. Sometimes, we must wonder about the antecedents or causes of an event and sometimes about its consequences. Other inferences are mostly focused on the connections, that is, on understanding why an event is cause or consequence of another one. Finally, the difficulty of these causal inferences is presumably conditioned by the information degree of accessibility. Frequently, the readers are required to start from their prior knowledge to reconstruct that information not explicitly appearing in the sources or documents consulted. This last type of mental actions are the most important to achieve a deep comprehension of the model of the historical situation (Voss & Ney, 1996). However, limitations to understand the causal model do not reside exclusively in the lack of previous knowledge. Limitations at the moment of combining multiple causal relationships simultaneously in the work memory (Voss et al., 1994) or the lack of active involvement on the part of the pupil in the causal explanation (Chi, 2000), constitute other obstacles which is necessary to bear in mind when creating hypermedia materials.
Previous research has looked into the benefits of embedding navigational questions and cues into hypertext, in order to support reasoning and metacognitive reflection on different subjects (Collis & Meeuwsen, 1999; Kashihar, Hiroshi & Toyoda, 1999; Relan & Smith, 1996; Sumner & Taylor, 1998; Veenman, Elshout & Busato, 1994). Apart from the organization and the hypergraphic aids, inserting *interrogations* making the pupil reflect about important aspects or concepts in the document could be an adequate strategy in this direction (Taylor, Alber & Walker, 2002). Such questions, not only should make the reader review and clarify the explicit information or recover relevant previous knowledge. More specifically, should constitute aids to guide the reasoning about those conditions and intentions, explaining causal connections between events. Otherwise, the pupil hardly could escape from the so-called “narrative trap” (Duthie, 1986), that is, from limiting to describe what happened, without really grasping why each of the events exposed were generated. The scheme provides the sequence of causes and consequences of the phenomenon but not the content justifying why those causes have their corresponding effects and not others. Then, the main point in comprehension lies in trying to infer explicitly *why* each event affects the others, in order to build and contrast a mental model of the situation. In this direction, the **guiding questions** inserted in precise places in the hypertext (such as the graphic connections between the events) could guide the reasoning and review process of the explicit and implicit information contained in the diverse documents. At the same time, they could favour a more active involvement on the part of the pupil.

The present study was directed to explore a hypertextual materials with these two resources: the hypergraphic representation of the multicausal structure and the insertion of guiding questions (which the user should answer throughout the process of study of the documents). On the one hand, we wanted to compare it with another type of hypertextual format in network, more conventional, and also in comparison with a linear presentation modality in paper. On the other hand, most of the research about hypertextual typologies have focused mainly on the speed and accuracy at the time of answering questions or locating explicit information in the documents. Our aim was to estimate the utility of these tools as a didactic resource for much more complex tasks, such as the multicausal historical reasoning.

**Method**

**Participants**

The sample consisted of 69 pupils (40 boys and 29 girls with an average age of 16.1), belonging to middle-lower classes, from a Secondary school. Their academic levels (i.e., vocabulary, knowledge, oral and written expression and comprehension levels) and motivation towards studies were equally low.

The subjects were randomly assigned to three conditions, related to the presentation format of a History content (about the Discovery of America): **Hypergraphic format with a multicausal organization** (Hypergraphic condition), **Hypertextual format with network organization** (Hypertext condition), and **Linear textual format** (Text condition).

The subjects’ academic performance in the linguistic and social sciences areas, the previous knowledge about the thematic content, and also the degree of familiarity with computer use and with navigation throughout hypertexts were taken into account to make sure of the initial homogeneity of the experimental groups.

**Intervention materials**

a) **Hypergraphic format, with a multicausal organization** (acceding to the information by means of an arrow diagram) and **causal questions inserted in the graphic arrows** (Hypergraphic condition). The resultant expositive document was a hypertext whose main page reproduced a graphic showing the causal relationships between the different sections in which the theme was divided. A total of 19 expositive documents plus one used as a glossary of terms were elaborated. Each document had an average extension of 180 words (with documents ranging from 53 words to a maximum extension of 316 words) and 16 lines.

Navigation was performed through this graphic. Clicking on any of the graphic boxes, the document the titles of that event or condition referred to, appeared. Clicking on any of the arrows connecting boxes, questions making reference to the explicit and implicit relationships between those events, appeared too. These questions were answered in paper
by means of a written questionnaire consisting of 28 items with 4 possible answers. Three types of questions should be answered using explicit information (about the causes, consequences or a causal relationship nexus) and four using relatively implicit information (about the causes, consequences, causal relationship connection or creative reasoning).

b) Conventional hypertextual format, with a non-interactive specific graphic and a brief questionnaire consisting of unspecific questions (Hypertext condition). It consisted of a conventional hypertextual document with a frame on the left where the epigraphs in which the document was divided appeared. Clicking on any of those links you can navigate to the headline of the epigraph at issue. Another way of navigating through the document was by means of the slider placed on the right of the screen, because the document could be read in a linear way downwards. At the end of the document the same causal scheme as in the previous hypermedia format was reproduced, but without the possibility of clicking on it to link with those sections it referred to.

Besides, in this format, the subjects answered a written questionnaire in paper consisting of unspecific questions not inserted in the content causal structure. In all, they had to answer 10 easy questions about dates, data or explicit ideas dealt in the reference document, similar to those we can usually find in text books at the end of each unit.

c) Linear textual format, with the same graphic and the same questionnaire used in the previous modality (Text condition). Unlike Hypergraphic and Hypertext conditions, the subjects did not have to read the information on a screen, but on the paper itself: a thirteen pages booklet where the same content and in the same order as those appearing in the conventional hypertextual format were reproduced. In the last page, the same causal scheme contained in the other formats appeared.

**Assessment materials**

As dependent variables, different kinds of causal reasoning, exposed in Table 1, were considered. The assessment was based on a series of tasks which were applied immediately after the material study, except the delayed assessment test, made a week later.
Table 1. Causal Reasoning Assessment

<table>
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<tr>
<th>Tasks</th>
<th>Causal inferences</th>
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<tbody>
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<td>Summary (immediate)</td>
<td>• Quantity of causal factors remembered</td>
</tr>
<tr>
<td></td>
<td>• Quantity of causal relationships remembered and explained</td>
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<td></td>
<td>• Global quality of the causal explanation</td>
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<tr>
<td>Multicausal reasoning test (immediate)</td>
<td>• Importance hierarchy of the diverse causal factors</td>
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<td></td>
<td>• Appraisal of the number of causal factors explaining a consequence</td>
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<td></td>
<td>• Elaboration of inferences about the causal nexus between two events (from explicit and implicit information)</td>
</tr>
<tr>
<td>Explicit and implicit information inference test (delayed)</td>
<td>• Elaboration of inferences about the causal factor or the consequence of an event (from explicit and implicit information)</td>
</tr>
<tr>
<td></td>
<td>• Elaboration of inferences about the causal nexus between two events (from explicit and implicit information)</td>
</tr>
<tr>
<td></td>
<td>• Elaboration of creative inferences about the situation model</td>
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</table>

a) **Summary.** In the first task they should elaborate a summary as an explanation of the most important aspects studied and the causal relationship between them. Appraisal was based in two criteria. On the one hand, the number of factors and causal relationships remembered by each subject. On the other hand, the global quality of the causal explanation built by each pupil was qualitatively appraised. To do that, the historical causality appraisal scale made by Domínguez and Pozo (1998) was used. Basing on previous studies, these authors point out five levels in the appraisal of the quality of the causal explanations provided by the subjects when dealing with tasks of this nature:

- **Level 1:** absolute absence of the notion of cause as a factor relating facts between themselves. Facts or events appear as an unconnected set.
- **Level 2:** facts are inserted in an undifferentiated chain through a temporal sequence of such facts.
- **Level 3:** subjects seem to understand a certain notion of causality and they are able to recognize that a cause can affect more than one event or that a certain event can be affected by several causes at the same time. However, these relationships are not systematically explored or analysed.
- **Level 4:** subjects establish complete causal connections between the events, appreciating the interactions between them and its reciprocal relationships.
- **Level 5:** subjects, not also are able to establish a complete and reciprocal causal connection network between the events, but also to locate these in their corresponding spatial-temporal context.

b) **Multicausal reasoning test.** The student’s multicausal reasoning capability was appraised by means of three convergent tasks:

- **First of all,** subjects were asked to establish a hierarchy with the degree of importance of each factor at the time of explaining the *Discovery of America*, reasoning their answers. Previously, three History teachers had estimated which should be the ideal hierarchy for this test.
- **Secondly,** they were asked to explain how many causal factors had intervened in their opinion and to explain the Discovery by means of these factors.
- **Finally,** to appraise the elaboration of implicit and explicit inferences, pupils answered a test whose questions made reference to the causal relationships and connections between certain contextual aspects of the epoch and the causal factors exposed, and also between the factors themselves.

c) **Delayed assessment test: implicit and explicit inferences.** The last assessment test was a questionnaire consisting of 24 items, each with four possible answers, demanding the elaboration of inferences about the causal factor, consequence or about the causal nexus between two events (taking as starting point the explicit and implicit information).

**Procedure**

Subjects were randomly assigned to the three experimental conditions. Due to internal policies in the educative centre where the tests were carried out and due to the availability of use in the computers room, tests were performed
at different morning hours along different days throughout two weeks. The groups associated to the different experimental conditions carried out the tests simultaneously and in the same room, under the researcher’s supervision. Two consecutive sessions were needed for the experimental session: 60 minutes were devoted for the consultation of the document about the Discovery of America (at the same time the pupils answered the questions in a self-evaluation questionnaire), and 30 minutes for the fulfillment of the immediate assessment tasks, without the presence of the document. A week later, during 30 minutes in a normal Social Sciences session, pupils answered to the questions contained in the delayed assessment test. The Social Sciences teachers provided no information about the Discovery of America to any of the groups involved neither in the previous weeks nor during the performance of the tests.

The degree of involvement in the task at the time of answering the different questionnaires, and also when consulting the documents of each experimental condition, was quite low. Many of the subjects did not answer those questions demanding a greater effort (open-ended questions) or those questions at the second half of the questionnaire just by demotivation. No subject showed difficulties when using hypergraphic or hypertextual formats, nor orientation problems at the time of consulting the different files of which the document was composed of. In general, subjects under Text condition finished earlier of consulting the whole document.

Results

Summary

A 37.5% of the subjects included in Hypergraphic condition, a 59.09% in Hypertext and a 47.82% in the case of Text condition, did not answer this test, that is, a 48% of all the subjects, what obviously reduces the interpretation of the results shown in Table 2. Most of the pupils left this test blank, not because they were not able to write, with higher or lower quality, a summary of what they had read, but, simply for unwillingness.

As to the quality of the summary, the level of the causal or historical explanations for most of the subjects would be between level 2 and level 3 of the scale described by Domínguez and Pozo (1998). Scarcely a third of the subjects was able to establish such causal relationship between some of the factors. The subjects included in Hypergraphic condition obtained higher average marks. At first sight, it seems that the fact of having the scheme with the causal structure permanently present, made easier for this modality to remember in a more efficient way the main contextual factors and elements of the theme. However, there were no significant differences between the three experimental conditions as to the quantity of causal factors and contextual elements remembered.

| Table 2. Means and standard deviations in the summary test in the Hypergraphic, Hypertext and Text condition |
|---------------------------------------------------------------|-------------|-----|-----|
| Summary                                      | Modalities | M   | SD  |
| Number of summarized factors               | Hypergraphic | 0.67 | 1.20 |
|                                          | Hypertextual | 1.41 | 1.50 |
|                                          | Text        | 1.09 | 1.68 |
| Number of summarized relationships         | Hypergraphic | 0.17 | 0.48 |
|                                          | Hypertextual | 0.59 | 0.91 |
|                                          | Text        | 0.01 | 0.29 |
| Global quality of the summary              | Hypergraphic | 2.12 | 2.15 |
|                                          | Hypertextual | 0.59 | 1.33 |
|                                          | Text        | 1.17 | 1.75 |

Multicausal reasoning test

As to the three multicausal reasoning tasks, we could observe again higher average marks in hypertext with interactive graphic aids condition (Table 3). Such difference in favour of those individuals grouped in Hypergraphic condition is shown in 9 out of the 13 questions which composed the two blocks of questions related to the elaboration of explicit and implicit causal inferences, though they were not statistically significant.
As to the question of how many and which factors would explain the Discovery, there were not differences between
the subjects included in the three experimental conditions either. A third of the subjects did not answer the question.
A 26% considered that several factors exerted influence (in general, those factors most of the subjects valued). A
20% considered that there was only one causal factor explaining the historical event. Finally, just a 20% considered
that all the factors had an influence in a higher or lower degree.

This absence of significant differences repeated again in the question related to the appraisal of the importance of
each causal factor. It is necessary to stand out the tendency to appraise those factors of an intentional or motivational
kind (personal factors) over those of a structural kind.

| Table 3. Means and standard deviations in the causal reasoning test and in the causal inference test in the |
| Hypergraphic, Hypertext and Text condition |
| --- | --- | --- | --- |
| **Reasoning** | **Modalities** | **M** | **SD** |
| Hierarchy of factors (immediate) | Hypergraphic | 1.75 | 1.85 |
| | Hypertextual | 0.91 | 1.15 |
| | Text | 1.22 | 1.56 |
| Number of factors (immediate) | Hypergraphic | 1.08 | 1.21 |
| | Hypertextual | 1.04 | 1.40 |
| | Text | 0.87 | 1.29 |
| Causal inferences (immediate) | Hypergraphic | 3.19 | 3.03 |
| | Hypertextual | 2.00 | 3.06 |
| | Text | 1.54 | 2.65 |
| Information inference test (delayed) | Hypergraphic | 6.30 | 4.33 |
| | Hypertextual | 4.18 | 3.84 |
| | Text | 4.96 | 5.02 |

**Information inference test**

Subjects in Hypergraphic group got better marks than the rest in all the questions asking explicit and implicit
information inference (table 3). The other two groups got very similar marks. Even though this could indicate that
the graphic aid provided to the Hypergraphic group has helped to better identify the relationships between each
causal factor and their contextual conditions, differences were not significant either.

If we analyse the success percentages in the different types of questions designed for this test, subjects included in
Hypergraphic condition got better percentages than those included in Text group in all the questions types, and better
than those included in Hypertext group in all the questions, except in those related to the causal nexus (Table 4).

| Table 4. Success percentages in each of the inference types (delayed) in the Hypergraphic, Hypertext and Text |
| condition |
| --- | --- | --- | --- | --- | --- | --- |
| **Modality** | **Causal** | **Consecutive** | **Nexus** | **Creative** | **Explicit** | **Implicit** |
| Hypergraphic | 43.7% | 41.6% | 34.35% | 39.2% | 39.08% | 40.32% |
| Hypertextual | 28.6% | 34.8% | 37.45% | 35.6% | 32.6% | 34.8% |
| Text | 32.12% | 36.15% | 26% | 38.4% | 32.2% | 32.5% |

**Discussion and conclusion**

The main goal of our research was to compare the effect of different modalities for improving multicausal reasoning,
combining different formats and aids. The results are congruent with those provided by the researchers mentioned in
the introduction regarding the difficulty of showing significant differences as to the hypermedia format presentation
with materials relatively complex (McKnight et al., 1992; Britt et al., 1996; Goldman, 1996; Shapiro, 1998; Barnab,
However, it can be observed a trend toward obtaining better results in those pupils who studied the hypergraphic format, with a *multicausal organization* and with *guiding questions*, designed to favour causal inferences. This is clearly shown in the fact that those subjects included in Hypergraphic group got better average marks in the different causal reasoning tasks. We have also clues proving that the graphic aid (a multicausal diagram, used as a navigation map) made easier the reference actions of the information. So, in spite of the lack of experience on the side of the subjects as to what supposes to consult a complex information in a hypertext, these never showed orientation problems.

There are two main reasons to explain why we can not observe a clear influence of the materials used in the study. On the one hand, the hypergraphic resources designed could not be really efficient to promote causal reasoning. On the other hand, these resources could not be adapted to the navigation strategies and to the characteristics of the subjects who took part in the study.

As to the first question, it is possible that either the representation of the causal content or the design of the guiding questions did not constitute adequate resources to success in involving students in the causal reasoning process. Instead of providing an *organization and a graphic representation* already made, Masterman and Sharples (2002) found positive results with a software which allowed students to build their own causal graphic from the linear reading of a historical phenomenon. Besides categorizing the properties of each event and connect them causally, subjects had to explain and justify the graphic made behind their classmates, what made easier the reflection and review of their implicit conceptions. In the same direction, Ravenscroft (2000) has found positive effects in the causal explanations about a Physics content from subjects exposed to simulated situations of dialog by means of a computer’s tool. On the contrary, in our case, pupils did not have the opportunity to re-build the representation of their own causal model, nor took part in discussion activities about such model, what probably could have improved the results in the causal reasoning tasks.

The *guiding questions*, could help to generate causal inferences about the causal connections. In fact, if we base on the data collected through the delayed assessment test, subjects in Hypergraphic condition get higher success percentages in almost all the types of questions. Sinatra, Beck y McKeown (1993) found that a group of students who, during the reading of several Social Sciences texts, had to answer to causal questions, got better results than those who read the original text and even those who read a reviewed version, but differences were not statistically significant either. A reason why the use of this type of mediators tends to produce only small gains could have to do with an argument affirming that “answering questions is useful to achieve the goals of others, instead of being useful to review the own comprehension problems” (Chi, 2000, p. 225). Those inferences generated by means of this aid in the Hypergraphic modality would only serve to complete pieces of information or to join unconnected pieces of it. On the contrary, readers would use the self-explanations to review and repair their mental model when they find a conflict between this and the information contained in the text. In this direction, the experiments designed by Chi (1994) encouraged pupils to formulate self-explanations while reading aloud. Those who elaborated a greater number of self-explanations, got higher levels of learning than those formulating an inferior number, and these, in their turn, got better results than those who simply read the text several times. A more powerful resource than that incorporated to the hypermedia format would be, therefore, to design inferential engagement activities in a e-learning environment. The previous results reveal the risk of granting such resources a self-sufficient character, within the technologic tool being implemented. More elaboration regarding inference, reasoning and graphics design are encouraged. In future research, it is necessary to explore its complementation with causal discussion activities, such as those which some History teachers usually perform.

On the other hand, the observation of the *reading strategies* followed by the subjects during the experiment, bring us another possible explanation about the results found. In a first reading of the documents, both the subjects in Hypergraphic condition and those in Hypertext followed a linear reading strategy, similar to that used by subjects in Text condition. Only after this first reading, subjects adopted a different strategy, mainly because they had to carry out a specific task (answering to the guiding test), skipping from some documents to others to find the information needed. The reading strategy can be, in consequence, hiding away the effect of the other variables over the results obtained by the subjects, as also has been observed in other studies (see Foltz, 1996, or Potelle & Rouet, 2003). A fact supporting this last analysis can be deduced from the tendency of the subjects in Hypergraphic condition to bring out “the desire for adventures” factor in a higher degree than the subjects belonging to the other two experimental conditions. This result can only be explained as a consequence of the linear reading strategy followed behind the navigation map found in the hypertext home page. The “desire for adventures” factor was located at the top of the

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multicausal diagram (see again figure 1) and was the first of the causal factors subjects of this condition would read following a linear scheme (from top to bottom and from left to right).

Finally, there can be no doubt that navigating throughout the information contained in a hypertext involves a cognitive over-effort for the subject. The smaller is his/her reading level and experience in the use of hypertexts, the greater is the effort (McKight, Dillon & Richardson, 1990; Rouet et al., 1996). In this direction, another possible fact which would explain why hypermedia formats have had so limited effects could be related to the low academic performance of the sample. In fact, clear differences between the questions about explicit and implicit information were not found. The model which most of their summaries reflect would be “subject plus details”, that is, a group of unconnected ideas about diverse contextual factors or elements of the Discovery of America not showing the comprehension of the historical event such texts refer to. A low engagement in the task could influence on the results as many pupils did not answer those open questions due to unwillingness or tiredness. Having into account the importance of the personal involvement of the pupil in this type of tasks, it is crucial to do research work on these personal factors in later studies.

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