

# Learning and Reasoning from Multiple Texts and Graphics in History

*Margarita Limón*

*University Autónoma of Madrid*

*Iván Pavlov, 6, Cantoblanco, 28049 Madrid (Spain)*

*Margarita.limon@uam.es*

**Abstract.** The aim of this proposal is to study the interaction between individual variables (i.e. educational level, epistemic competence and the level of in-group identification) and the characteristics of the learning material designed to present an ill-defined historical problem (i.e. the type of navigation –free or guided exploration of the documents presented) in order to promote learning. About one hundred students (freshmen and 10<sup>th</sup>. graders) participated in the study. Participants were introduced different types of documents: press clippings, textbooks and handbooks, cartoons, bar graphics. How individuals selected, interpreted and integrated the evidence presented was assessed. Learning between the pre-test and the post-test was also measured. Participants showing a higher level of epistemic competence dedicated more time to the evidence presented and learnt more than participants with lower epistemic competence. 10<sup>th</sup>. graders learnt more in the free exploration condition, whereas freshmen learnt the same in both conditions.

**Keywords:** Multimedia learning; multiple documents; sourcing; reasoning; history; ill-defined problem solving.

## **Aims of the Study**

The empirical data I will present in this presentation belong to a larger project that intends to study the interaction between some features of the learners (e.g. prior knowledge, educational level or students' epistemic competence), and some features of the design of the learning material (e.g. type of navigation to browse the evidence presented: free or guided; modality of the documents presented) in order to improve learning about a historical topic in this case.

Last decade research about learning with multimedia materials or learning from multiple texts and graphics have shown that learning materials cannot be assessed as good ones or poor ones in absolute terms. How good or how poor they are in order to foster learning seems to depend both of *who* will learn from that material, and *how* the material is designed. The reversal effect of expertise described by Kalyuga (2005) illustrates this. Also Cohen & Hegarty (2007) and Stull, Hegarty & Mayer (2009) obtained that orientation references were especially useful for individuals with low-spatial-ability in a virtual learning anatomy task. Schwartz et al. (2007) found that familiarity with geographical locations influenced how their undergraduate students used a map presented in a website page. When students were familiar with the location, more content from the web page presented was learnt if the map was absent. However, when students were not familiar with the location, a higher level of information was learnt when the map was present.

These examples illustrate the relevance of knowing more in detail how to fit in the features of the learning material design with the learners' characteristics to improve learning. The data I present here intend to make a small contribution to achieve this long-term goal. This is the first and more general aim of this proposal.

The second aim of this study is to explore how students' reasoning about a particular historical topic may be influenced both by individual variables such as prior knowledge, epistemic competence or social identity, and external variables such as the way evidence is organized and signaled, or how evidence can be browsed (self-pace exploration vs. fixed programmed exploration).

Controversial issues in which documents from multiple sources are presented and several views may be held appear frequently in history. Historians have to select, to interpret and to integrate the evidence collected to generate their explanation of what happened. Here, I will focus on how students

select, interpret and integrate the evidence for generating an explanation about a historical topic (the war between Spain and the USA held in Cuba in 1898). The research questions of this proposal are: What type of evidence –press clippings, textbooks, handbooks, cartoons- is considered more reliable and useful by the participants? How do individual variables (prior knowledge and epistemic competence) influence the process of selection, interpretation and integration of evidence? Does the way evidence is presented and explored influence either students' reasoning process or their learning? What type of navigation and personal characteristics improved learning?

## **Method**

### *Sample*

Two groups of Spanish tenth graders (n= 49), and freshmen (n= 51) participated in the study. Participants had low prior knowledge and interest about the topic of the problem (the war held in Cuba between the USA and Spain in 1898).

### *Procedure*

Each participant completed three sessions. In the first session, before the problem was introduced, prior topic knowledge, epistemic competence about historical knowledge, and the level of in-group identification were assessed.

The historical problem was introduced in the second session. Participants were introduced a summary about the situation of Cuba in 1898, and ten documents they had to review before answering the key question of the problem (*What government was the most responsible for the outbreak of the war?*). Five documents supported each view of the conflict (USA vs Spain). Documents presented several types of evidence and sources (bar graphics, cartoons, textbooks and handbooks, and press clippings). Then, participants evaluated each document presented (*review phase*), and they answered the key question again. Finally, they were presented arguments that were in conflict with their previous answer (*conflicting data phase*), and they were asked their final answer.

In the third session, post-test measures were taken to assess individuals' learning about the topic of the problem, and their degree of awareness of their use of the information presented in the documents.

Each group of participants were assigned to two different experimental conditions: a) Guided presentation of evidence, and b) Free exploration of evidence. In the first condition, the documents supporting the Spanish view were presented first, followed by those that supported the USA view. Once they had been presented all documents, they were allowed to review them again. Instead, in the second condition (free exploration of evidence) the documents were introduced at the same time and participants' were told to explore them as much as they want for a maximum period of time (40min).

## **Results**

### *a) Selection of evidence: Reliability and usefulness of the documents presented in the problem*

An ANOVA repeated measures with three between-subjects factors (Type of Navigation –free vs. Guided- and Educational Level -10th. Graders, freshmen-; Epistemic competence –low vs high-) and one within subjects factor (Reliability) was performed. Results showed no significant effect of educational level and epistemic competence, but a significant effect of both type of navigation ( $F_{1,93}=4,239, p=.042$ ) and reliability ( $F_{9,93}=2,256, p=.040$ ). Documents were assessed as more reliable in the guided condition than in the free condition, and there were differences among the reliability score given to the different documents. Economical data were considered the most reliable whereas cartoons and press clippings were considered the least reliable. The same analysis was performed about the usefulness of the documents presented. There was no significant effect.

### *b) Interpretation of evidence*

A three way ANOVA with three between-subjects factors (Educational Level, Level of Epistemic Competence and Type of Navigation) was performed for the total number of documents supporting each of the four possible views. Analyses just revealed a significant effect of educational level for the total number of documents that were interpreted as supporting both Spain and the USA views ( $F_{1,96}=5,492, p=.021$ ). Most documents were interpreted as supporting the Spanish view or the “none of them” view. The mean number of documents that participants interpreted as supporting the USA view was .87,  $Sd=1.87$

c) *Integration of evidence*

A measure of coherence between individual’s interpretation of evidence and his final answer to the key question was calculated. About a 58% of participants were not coherent. Chi-square tests did not reveal significant differences either for Coherence x Type of Navigation or Coherence x Educational Level.

d) *Learning*

The time each participant looked at each document was calculated. An ANOVA repeated measures with two between-subjects factor (Epistemic Competence and Educational Level) and one within subjects factor (Time) was performed. Results showed a significant effect of time:  $F(5.63,349.20)=11.93, p=.000$ ; and also a significant effect of the level of epistemic competence  $F(1,62)= 6.57; p=.013$  and of the interaction Epistemic Competence Level x Time  $F(5.63,349.20)=4.208; p=.001$ . Individuals showing a highest level of epistemic competence spent more time looking at the documents. Also participants that showed a higher level of epistemic competence improved significantly more from pre-test to post-test ( $M=3,53, SE=1.00$ ) than those showing a lower level of epistemic competence ( $M=6,23, SE=.685$ ),  $t(62)=-2.16, p=.034, r=.26$ .

An ANOVA with 2 between-subjects factors (Type of Navigation, Educational Level) and “improvement” (post-pre test difference) as dependent variable was performed. A significant effect of Educational Level was found:  $F_{1,96}=9,639, p=.003$ . No significant effect of Type of Navigation was found. A significant effect of the interaction Educational Level X Type of Navigation was found ( $F_{1,96}=3,995, p=.048$ ). 10<sup>th</sup>. graders learnt more information in the free navigation condition, whereas freshmen learnt the same in both navigation conditions.

## **Discussion and Conclusions**

A detailed discussion of the results will be included in the paper as well as in the meeting presentation. Educational implications for the design of multimedia learning materials in history will be developed.

## **References**

- Cohen, C.A., & Hegarty, M. (2007). Individual differences in use of external visualizations to perform an internal visualization task. *Applied Cognitive Psychology, 21*, 701-711.
- Kalyuga, S. (2005). Prior knowledge principle in multimedia learning. En R. E. Mayer (Ed.) *The Cambridge Handbook of Multimedia Learning* (pp. 325-337). New York: Cambridge University Press.
- Schwartz, N.H.; Verdi, M.P.; Morris, T.D.; Lee, T.R., & Larsson, N. K. (2007). Navigating web-based environments: Differentiating internal spatial representations from external spatial displays. *Contemporary Educational Psychology, 32*, 551-568.
- Stull, A.T.; Hegarty, M., & Mayer, R.E. (2009). Getting a handle on learning anatomy with interactive three dimensional graphics. *Journal of Educational Psychology, 101*(4), 803-816.