

## **PEDAGOGICAL EVALUATION OF A WEB-BASED TRAINING IN EMBRYOLOGY: A STUDY OF IMAGE-TEXT COMBINATIONS**

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### **BACKGROUND**

As part of the Swiss Virtual Campus, the WBT course aims at creating and implementing an interactive 52-hour web-based training course in embryology for first and second year (preclinical) medical students. Institutes of three Swiss universities (Bern, Fribourg and Lausanne) collaborate to develop this courseware which includes different interactive tools in order to facilitate the autonomous learning process of the students (Schöni-Affolter et al. 2001).

From a pedagogical point of view, the project develops along two axes. First, a continuous formative evaluation is processed to feed and to validate the interface development (Dokic 1989), according to the courseware scientific contents and learning tasks. Second, a summative pedagogical study will determine globally the advantages and limits of the courseware pedagogical situation, with regards to the learning efficiency.

### **PURPOSE OF THE STUDY**

The present paper is focused on the continuous formative evaluation process of the WBT courseware. This evaluation is based on different focused studies conducted with different groups of students. Each study tests a particular aspect with a double aim:

- Improving the conception/realisation team efficiency by avoiding egocentric and endless discussions and by enhancing taken of decision (Krug 2000)
- Improving the interactive tool learning efficiency (Dillon et al. 1998)

The specific study, presented here, is dedicated to the definition of the most efficient image-text combinations to be implemented in the courseware that includes images of different types: drawings, photos, videos and interactive schematics. Indeed, within a traditional medical course, the different forms of images are a very important didactic support of the learning process (Clément et al. 1996). More precisely, these are the different combinations, of verbal and pictorial information, which are crucial. As a consequence, one of the real challenges of the WBT project is to take advantages of this multimedia potential.

### **METHODS**

“The didactic thumb-rules which are nowadays used in multimedia design frequently result in wrong decisions, which can be an obstacle rather than a support for learning (Schnotz 2001)”. It is thus very important to take into account and to apply recognised experimental results, coming from the fields of psychology and pedagogy, in instructional design. The results, dealing in particular with image-text combination efficiency for reading task memorisation and comprehension, are of special interest for the WBT project.

These results are analysed in a literature study so to determine the most efficient image-text combinations to be implemented in the courseware. A questionnaire, given to the students, is then used as a second methodological tool in order to verify if the image-text combinations are implemented correctly, according to the literature results.

### **Scientific literature analysis**

One could first consider the memorisation effect of image-text combination. The dual coding theory explains that text information is remembered better when it is illustrated by pictures (Paivio 1986). Other scientists established that illustrations, inserted into a text, have five different functions: transformation, interpretation, organisation, representation and decoration (Levin et al. 1987). Depending on its function, the illustration has different beneficial effects on the text memorisation. The best effect happens when the function is transformation (the illustration recodes the information of the text) or interpretation (the illustration allows to make real some of the information in the text). The worst effect happens when the function is decoration (the illustration has no semantic relation with the text).

Image-text combination implies also potential positive effects on the comprehension of the verbal information. The comprehension of an image-text combination necessitates the construction of two mental models (one for the text and one for the image) which help each other as long as their confrontation is positive. Thus, they should be presented contiguously and they must be coherent with each other (Mayer 1997). A positive confrontation of the two models will also be favoured if the image is presented first (Kulhavy et al. 1994). Furthermore, learners with low prior knowledge will profit very much from images in text; instead learners with high prior knowledge will not profit much (Schnotz 2001). At last, the number of image-text combinations has to be limited to keep the cognitive cost they imply lower than the support they bring for comprehension (Ainsworth 1999). The same results globally apply to the use of animations into a courseware (Mayer et al. 1992).

### **Student analysis**

The evaluation of the chosen text-image combination implementation is done when the first course session using the WBT courseware prototype is given. About 130 first year medical students used the prototype during one complete month (January 2002). Then they were asked to fill a questionnaire. 98 students volunteered and 53 of them gave it back.

The questionnaire does not evaluate what the students know about the cognitive process principles extracted from the literature analysis. The aim of our analysis is to determine if these principles are applied correctly into the prototype. The questionnaire measures how students perceive the image-text combinations that are implemented. This implies that the questions are not like: "Do you memorise textual information better when it is associated with an image?" On the contrary, they are more like: "Did you have difficulties to know what image completes what text? If yes/no, why?" Or, "In what way are images completing texts?"

For the measure of obstacles, due to an image interfering with a prior knowledge, students are asked to say for thirty concepts if they knew them before or learned them during the course. Ten concepts are prerequisites students should know before entering the first year in medicine. Ten other ones are no prerequisites and neither parts of the course objectives; no image is then associated to them into the courseware. On the contrary, images are associated to the last ten concepts that are course objectives. The thirty concepts are randomly mixed.

## **RESULTS**

### **Chosen image-text combinations**

The literature analysis gives clear indications on how to design the courseware for favouring memorisation and comprehension. First, image-text combinations should be used instead of separated verbal representations (text) and visual representations (image). The web pages, containing associated texts and images (drawings, photos, videos and interactive schematics), must then be designed in such a way that the association becomes natural and correct. Second, the images used must be chosen so to have a function of transformation or interpretation. Third, images should be chosen while avoiding conflicts due to prior knowledge and while limiting their total number. This is achieved by using images when explaining unknown concepts, concepts that are part of the courseware learning objectives. The combinations are then less in number and can less interfere with pre-developed mental models.

### **Questionnaire analysis**

The image-text association process is said to cause no difficulty by 83% of the students. The correctness of the association they make can be seen within the results of two other questions. First, 91%, of those 83%, are using the unambiguous image legend. Second, a design rule is applied for making the image-text association more natural into the web pages: images are placed below the text they complete and on its right side. 65.7% and 61.4% of the students perceive these visual regularities.

Drawings are used to determine the perception students have about the five functions an image can play (cf. literature study). Transformation (41.5%), interpretation (39.6%) and organisation (35.8%) are chosen first while representation and decoration play a secondary role (20.8% and 7.5%). This result is further consolidated. First, two sentences, defining transformation and interpretation, are chosen by 71.7% and 86.8% of the students. Instead the highest similar score, for organisation, is 54.7% only. Second, 71.7% of the students say they are using drawings both for memorising and learning the course contents.

Concerning the image number, 94.4% of the students assert the image-text ratio is good. The image number also seems to be quite adequate when the students evaluate the total number of images they have to memorise (normal work: 31.4%; very big: 17.6%) and to understand (normal work: 54.0%; very big: 14.0%) for achieving the course objectives.

About the image as possible obstacle, 79.8% of the students recognise the first ten concepts as prerequisites. It indicates the students distinguish very well the concepts they knew before and the ones they learned during the course. But three of the ten concepts with no image are considered as known before by 71.7% of the students and the other seven ones as learned during by 75.7% (average values). Furthermore, four of the ten concepts with image are considered as known before by 56.6% of the students and the other six ones as learned during by 67.9%. These two results could show that some images are missing and that some other ones are negatively interfering.

## CONCLUSIONS

From a methodological point of view, a formative evaluation process improves the learning efficiency of the WBT courseware. It allows to identify problems and to test solutions during its development. The results of a summative evaluation could not feed the prototype so easily.

The literature study gives clear indications, coming from already proven results, on the different ways images and texts should be combined to increase memorisation and comprehension of the courseware contents. Different results come from the questionnaire analysis. First, the contiguity principle is well applied into the courseware. Second, the image main functions are transformation and interpretation and this should favour the learning process. Third, the image number is adequate but the choice of the images, with regards to the student prior knowledge, should be further discussed within the WBT conception team.

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