

An organizational memory as support of learning in applied mathematics

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1. Introduction

The development and diversity of information resources used in e-learning training generate problems of access, classification and management. In this article, we present the results of a research study about knowledge engineering focussed on the use of an organizational memory on the basis of ontologies (hierarchies of concepts hierarchies) (Chaput & al., 2004). This work allows the capitalization and the diffusion of the knowledge contents and the resources related to the "Applied Mathematics" course which is part of the Licence MIAGE at the Picardie Jules Verne University of Amiens. This course deals with inferential statistics. We first briefly describe the students' work environment and we present a test of utilisability¹ which was developed and submitted to the students. We explain how their remarks were taken into account to design a new prototype.

¹ http://egov.wallonie.be/docs/implication_utilisateurs/fiche13.doc

2. MEMORAE² and E-MEMORAE³

2.1. MEMORAE

Within the framework of the MEMORAE project (Abel & al., 2006), a use of an organizational memory as a learning support allows the management of resources, information and knowledge contents in connection with a specific training. The ontology was built in order to present the course with notions and concepts. These notions are used to structure the course memory where the resources are indexed (exercises, books, on line courses, websites...) (Ducay & al., 2006).

2.2. E-MEMORAE

The E-MEMORAE environment allows the users free access to the resources by browsing in the ontology where they are indexed. The aim is to ease the acquisition of the notions listed in the course memory. The general principle is to give the learners either precise information about what they are looking for, or a partial tree of the ontology focussed on the notion studied which helps them to continue browsing in the memory by requests.

The interface presents entry points to notions (in the left frame), resources (in the bottom frame), a short introduction to the studied notion (above the tree) and the browsing history (in the right frame see Figure 1).

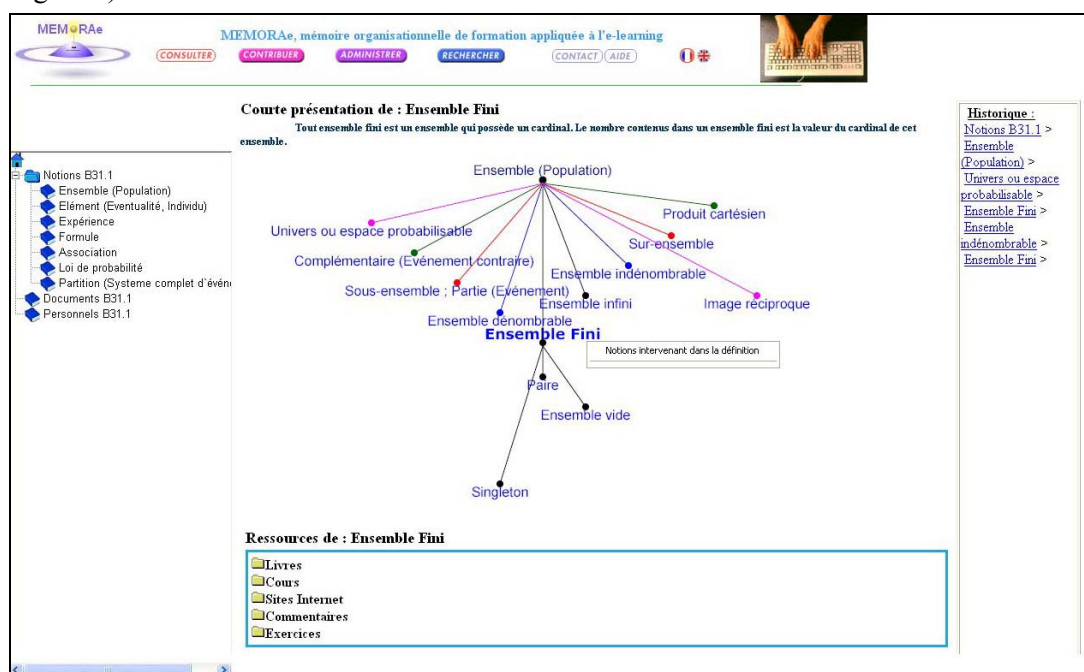


Figure 1: User interface

There are two kinds of browsing: the "vertical" browsing by a left click on a notion in order to explore the ontology with the specialization links (for example "set" can be specialized in "finite set" or "infinite set"), the "horizontal" browsing by a right click on a notion in order to reach the links related to the notion such as "Has for cardinality" or "Is the absolute complement of". Besides, the learner can stop temporarily the browsing in order to focus on a particular concept.

² MEMORAE is a French acronym for Organizational Memory in an e-learning context (in French MÉmoire ORganisationnelle Appliquée au e-learning).

³ <http://www.hds.utc.fr/~ememorae/Site-MEMORAE/>

3. Tests and results

In this section, we present the conditions and the results of the first tests done with the students of the University of Amiens (Benayache & al., 2006).

3.1. Objectives of the test

We used a test of utilisability in order to see how the students use E-MEMORAE to discover new notions by themselves.

3.2. Conditions of the test

First, in order not to bias the results, the students were familiarized beforehand with the environment and an exercise resolution was carried out for them as an example: the questions referred to the basic notions (random experiment, probability space, sample space, event, equiprobability...) and to calculation properties (usual laws of probability, expected value...). Then they were given the opportunity to practice the environment freely. This was not useless for some of them.

Then the students had to complete the test proper; it lasted two hours in a computer room with Internet access. The students had to solve a problem, with three parts, about two main subjects:

- Description of Poisson's law of probability and comparison with the observed relative frequencies calculated on a sample with similar mean and variance.
- Estimation by confidence interval of the mean for a normal distribution with a known standard deviation.

The problem dealt with two kinds of notions:

- Known: Poisson's law, expected value, variance, statistical description of a univariate distribution (variable values, frequencies, relative frequencies, mean, variance...)
- Unknown: chi-squared adequacy test, mean estimation by confidence interval.

During the test, the students could only use E-MEMORAE. The students' browsing histories were automatically stored for us to be able to analyse how they reached the important notions and how they used the available resources.

Lastly, after the test, the students were questioned about the tool, about its ergonomics, about the website and they also had the opportunity to suggest improvements.

3.3. First results

41 students have participated in the test. 75% of them have appreciated the knowledge presentation. We designated by "FOR" the subset of these students and by "AGAINST" the other subset. The following table shows the results of the two groups with the main characteristics of E-MEMORAE.

Table 1: Summary of results

	FOR (32 students)	AGAINST (9 students)
None or few problems with the use of a hierarchy of notions	95%	45%
None or few problems with the tree display	95%	65%
Use of entry points	80%	60%
Consistency of entry points	90%	75%

It reveals a non significant difference in the grades obtained by the two groups of students. They averaged around 15/20. Students of both groups managed every question correctly which may means that

their opinions about E-MEMORAE are not directly linked to success in the test. Moreover, the questions that were not correctly treated are mainly related to notions which had not been thoroughly taught during the lessons.

In order to understand these results, we studied the browsing histories. We noticed that a majority of students had tried all the various possibilities of access to a notion: entry points, browsing, search engine and history. We also noticed that the AGAINST histories lasted longer than the FOR ones: the more dispersed search may have caused a waste of time during the test and made them feel that they had no time for a complete exploration. The study also proved that horizontal browsing had scarcely been used which may be accounted for by the fact that the students were not familiarized with the right clicking.

The notions required for solving the problem had been visited by one means or another. Some students had even consulted the nearby notions. Having studied the users' suggestions, we can point out various important conclusions:

- Sometimes, the tree diagram was overloaded and the items difficult to read;
- The semantic axes were not understood;
- The students claim they would prefer to have direct access to the notions rather than scanning the pdf file formatted document.

Part of their remarks (especially the tree visual display and the access to the course documents) were predictable and were caused by a lack of time due to the fact that we wished to complete all the tests by the end of 2005 in order not to postpone the experiment the next year.

4. Modifications

After this first test, we can conclude that the use of an ontology in order to index and structure learning content is a good choice: most of the students appreciated it. The results obtained among the students in the course, show that most of them were able to find the knowledge required for solving the problem. The suggestions expressed by the students in the questionnaire dealt mainly with practical aspects.

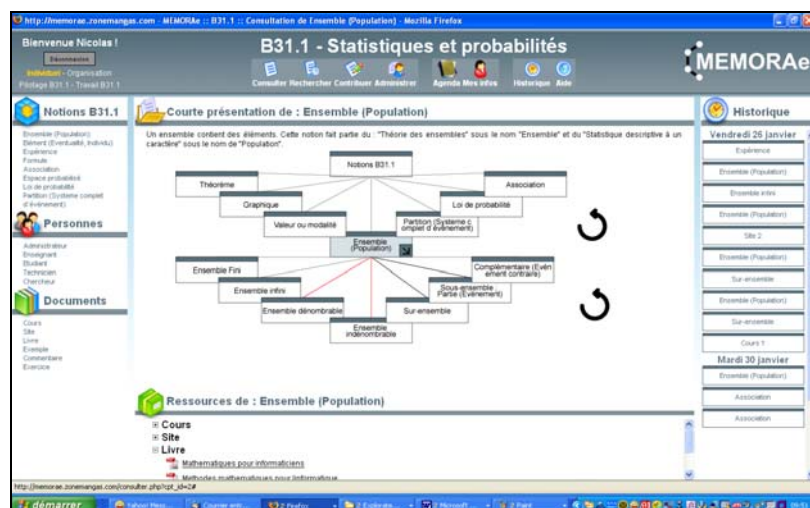




Figure 2: Example of the new user interface

We took these remarks into account for the new prototype (figure 2).

- A tree display: seven concepts only in each level with a device represented by the icon  allowing

the displayed concepts to rotate;

- Right click (horizontal browsing): addition of the icon  in the lower right corner of the concept frame;
- Semantic axes: nearby notions of a same axe are gathered;
- Memory feeding: the memory may be fed either by the teacher, or by the students in a private part, or by a group of students.

5. Conclusion

The E-MEMORAE project research required an analysis of the notions used in inferential statistics prior to an organisation of them. The module structuring built from the ontology makes the notions access easier and useful in other contexts. The "Statistics" module memory is currently available for learners in various schools.

Although the results of the test cannot be generalized, they are rather encouraging. As the students were able to find the knowledge required to solve the problem, it appears that using an ontology to index and structure the content of a training is a good choice. The approach by notion and the tree display do not disturb the students. For the most part, they have appreciated the environment because it allows e-learning in an "intelligent way" and because it points out the nearby notions.

The privileged approach developed in the MEMORAE project has been validated and we are currently working on using it in an organizational learning context (Abel & al., 2007). The new prototype is to be tested in the spring of 2007.

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