International Conference Advances in Infrastructure for e-Business, e-Education, e-Science, and e-Medicine on the Internet, L'Aquila, Jul 29 - Aug 04 2002, ITALY

Evaluation and perspectives of an innovative Tunisian e-learning experimentation

Henda CHORFI and Mohamed JEMNI

***Abstract*— In this paper we will present works realised by the team of e-learning of the Higher College of Sciences and Techniques of Tunis (ESSTT). At first, on the pedagogical plan, we describe the pilot e-learning experience recently done, the evaluation of this experience and our plans for the future. Secondly, on the plan research, we present our reflections around the concept of an intelligent system of e-learning and our conception of the architecture of a such system.**

Index Terms—e-learning, plat-form, LSA, AWL, Semantic analyzer.

I. Introduction

Nowadays, the number of students in Tunisia is about 250000, and the predictions affirm that it will reach 500000 in 2010, this number will be stable for some years, then it will decrease. For this reason teaching a proportion of courses by e-learning methods can be a solution to avoid building universities to be used for only several years and of course the cost of such investment. Furthermore, the development of on-line courses and concrete e-learning experimentations are very rare and yet unexplored [AB99]. In this context, the e-learning team of the Higher College of Sciences and Techniques of Tunis (ESSTT) worked since several years on two aspects: pedagogic and research.

II. Pedagogical aspect

Believing that e-learning is different from classical learning and that needs a new pedagogy which takes in consideration the new situations and tools of learning and teaching, the ESSTT proceeded, via a collaboration Tunisian-Canadian project, to acquire the Canadian platform Theorix for e-learning. This project allowed to train some teachers in numeric pedagogy and production of multimedia courses to diffuse them via Internet. This project allowed to do first experimentations of these new methods of web based teaching. The team of e-learning, constituted mainly by those teachers, contributed in the design of the first Tunisian e-learning platform called Waheeb [CJ02].

Effectively, at the beginning of 1999, Waheeb started as an academic prototype of an e-learning system designed and developed in order to have a pedagogical framework adapted to the Tunisian context and its learning system. Furthermore, at the beginning of 2000, e-com-soft, a Tunisian start-up, adopted the project and took the role of promoting and developing it. E-com-soft have worked and continues to work in collaboration with our research team to produce a professional and robust e-learning system that allows colleges and universities, corporations and commercial education providers to bring their academic, administrative, community and other educational services on-line.

II.1 Waheeb description

Waheeb is a Web-based learning platform that provides a fully integrated student environment, learning management system, and a range of custom content creation and publication tools. The goal of Waheeb designers is double: a general goal which is the contribution of the evolution of e-learning by the development of efficient system, rich in functionality and tools who assist users, especially teachers by means of high level Learning Content Services (LCS). Thanks to this LCS, teachers can create multimedia contents, integrating text, images, video, animations,… without requiring HTML programming. The second goal, which makes the originality of Waheeb, is specific : it's related to Arabic language. In fact, due to the unavailability of complete Arabic e-learning platforms, the objective was the development of a platform which can be used completely in Arabic, of course in addition of other languages such as English and French.

Waheeb offers three modes of use reachable via a Web navigator.

II.1.1 Student mode :

Student can learn accordingly to his appropriate rate of comprehension. He benefits of a set of tools that assist him during his learning process. The system lets him navigate freely in the course structure, download and print documents, communicate with his colleagues and teachers (an intern e-

Henda CHORFI is with the Computer Science Department, Ecole Supérieure des Sciences et Techniques de Tunis 5, Av. Taha Hussein, B.P. 56, Bab Mnara 1008, Tunis, TUNISIE (e-mail : Henda.Chorfi@esstt.rnu.tn)

Mohamed JEMNI is with the Computer Science Department, Ecole Supérieure des Sciences et Techniques de Tunis, 5, Av. Taha Hussein, B.P. 56, Bab Mnara 1008, Tunis, TUNISIE (e-mail : Mohamed.Jemni@fst.rnu.tn)

mail function), plan and organize his learning, homework and exams (calendar function), participate in a forum which is related to his course and animated by a teacher to share ideas and opinions with the virtual classroom, to take personal annotations, to discuss directly with his colleagues (chat function), to do interactive auto-evaluation exercises and to submit evaluation and works to his teachers.

II.1.2 Professor mode :

Professor benefits of a complete set of tools for content creation. It allows him to integrate any kind of material (text, image, video, flash animation, Java applets…) and hyper links to internal pages of the course or to extern Web sites. Those tools allow an easy production of high quality pedagogical material. In fact, the system doesn't need any HTML or programming knowledge. In addition, this mode offers to the teacher a complete set of tools for communication (e-mail, chat, forum, calendar), tutoring and evaluation of his students.

II.1.3 Administrator mode :

The task of the administrator is the management of the system users : students and teachers. He defines for each one his access rights and accords to him authentification login and password. He has to manage on-line registration of students in addition of the administration and the control of course sites that teachers realized.

The advantage of Waheeb, among others, is its richness of functionality for the three modes, its simplicity of use and its uniform environment presentation of courses. Finally, Waheeb gives more importance to social contacts of virtual class: students are allowed to edit and consult their profiles and personal pages.

II.2 Description of the experience

In order to explore the different aspects of this new mode of teaching and to analyze how it can be efficiently realized, the e-learning team proceeded to realize a pilot innovative experience of e-learning in Tunisia. It developed two courses of MS-Word and MS-Excel and started teaching a group of 130 students of the first year of computer science bachelor. The courses were developed by teachers with the help of two specialists in multimedia to treat images, audio and video and to prepare flash animation and Java applets. sequences and to prepare flash animation and Java applets.

The group of the 130 students was divided into 8 groups of 16 students. All students received 8 hours training in operating system and 2 hours training in the use of the Tunisian platform Waheeb which is a Web-based learning platform that provides a fully integrated student environment, learning management system, and a range of custom content creation and publication tools.

Although, the team had to choose between the two platforms Waheeb and Theorix. The choice was Waheeb platform for many reasons. The most important of them were :

- The simplicity of use : Waheeb offers an interface which can be easily used and based on three modes : student, professor and administrator whereas Theorix is based on five modes : system administrator, client administrator, author, facilitator and student.

- Uniformity : Waheeb presents all courses in an uniform way based on standard template with navigation tools and communication and customized functions.

- Richness of functionality : Waheeb is a three-language platform : Arabic, French and English, it has its own communication tools (e-mail, chat, forum, …). At any moment, a student can be able to know who from his colleagues is connected and can, then, contact him.

- Richness of the evaluation tools: Teachers can produce exercises in multimedia format and can interface them with any software related to the course.

- Inter-operability (import/export tools) : Waheeb can host contents created with standard HTML editors or other platforms. The contents created with Waheeb LCS can be, also, exported in HTML format and hosted in other platforms.

Finally, disposing of the source program of the platform was also an other reason to choose Waheeb system. In fact, thanks to this, we have the possibility to obtain all kind of data related to the use of the platform (i.e. time connection to a course, last date of connection, number of tentative before a right answer, …). This data is used therefore by the team for both pedagogic strategies and research.

II.3 Analysis of the experience

We note at first, that the experience started at the beginning of November 2001 and finished at the beginning of February 2002. To evaluate this experience, we have performed two kinds of analysis:

- Analysis of users appreciation : questionnaires were distributed to both students and teachers in order to obtain their appreciation about different aspects. For students, questionnaires focused, particularly, on the facility of using the platform, course's structuration, communication, … Whereas, for teachers, the questionnaires concerned two points of view: the pedagogic strategies and quantification of efforts required for this new learning and teaching mode, such as time of content creation, time spent to communicate with students (respond to e-mails, Chat, forum animation) and time needed to correct assessments.
- Statistical analysis of data delivered by the platform (table I) : our object here is to know the rate of the use of tools and resources and to constitute eventually relations between the relevant criteria and aspects of e-learning such as the use of a particular tool and time of connection or number of visits…

The table below shows statistical analysis of data delivered by the platform. Data is concerning the two courses of the experience:

TABLE I

STATISTICAL ANALYSIS OF DATA DELIVERED BY THE PLATFORM

WORD COURSE		EXCEL COURSE	
Average of visit number	Time of connection (min)	Average of visit Number	Time of connection
16,024	207,488	11,632	209,752

The analysis of questionnaires shows many facts presented in the points below :

- More than 85% of students have appreciated the experience as shown by the fig. 1.:

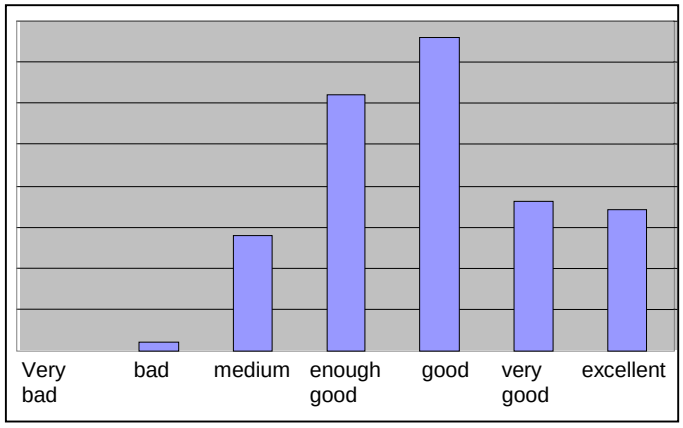

Fig. 1. Students appreciation of the experience.

- Although many students have some knowledge before pursuing the two courses, the majority have learned new things (Fig. 2).

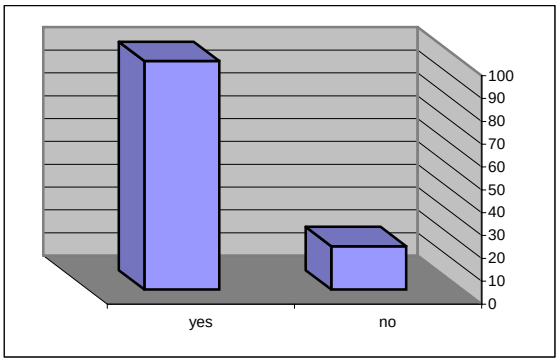

Fig. 2. Number of students who learned new knowledge.

- Students have been used to the new mode of learning gradually. The fig. 3. shows that, at the beginning, they don't respect the deadlines of evaluations but gradually they do it .

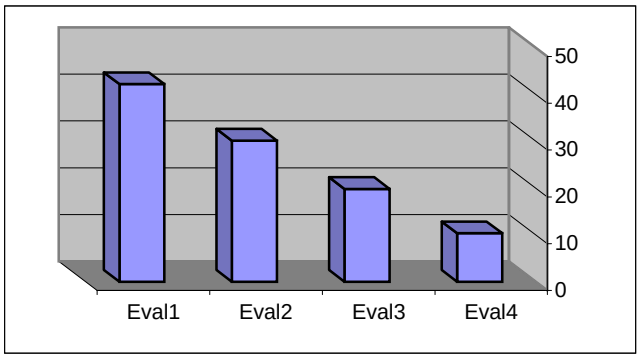

Fig.3. Non respect of deadlines of evaluations

- The questionnaire shows that most students prefer e-mail tool to communicate (figure 4), few students used chat and a very small number of students used forum.

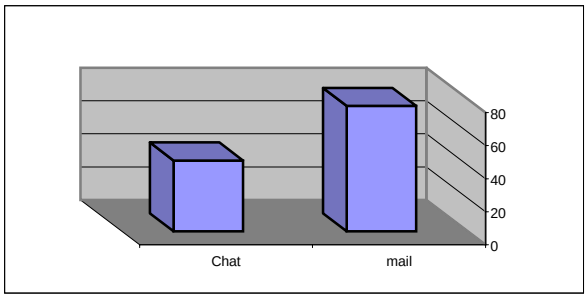

Fig. 4. The most used communication tool

- Most students find that the chat tool is useful but not necessary, and the majority used it for others objects rather than learning or didn't used it at all (Fig. 5.)

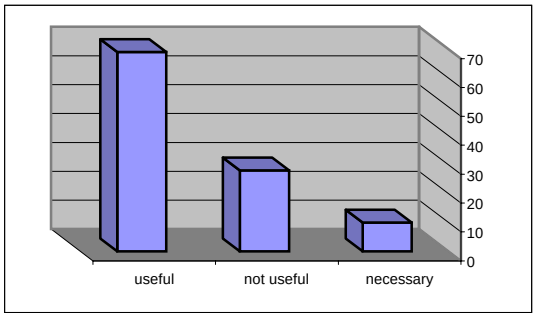

Fig. 5a. Appreciation of chat tool

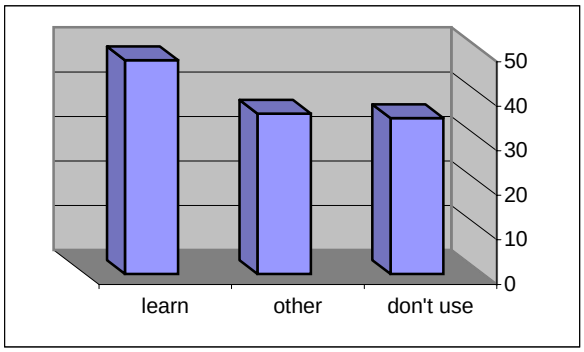

Fig.5b. The object of chat use

II-4 Synthesis of the experience

From the above analysis, we can affirm that the experience was very successful and allowed us to enumerate the following positive points:

- Elimination of psychological barrier : students can ask questions and do pretests without the hesitation and the inconvenience of classical situations.
- Discrete contacts : student can freely communicate with his teachers or colleagues via e-mail or chat.
- Personal annotation : indeed courses are available, students can take annotations and remarks which they find pertinent.
- Possibility of feedback : students can review all notions at any time.
- Respect of individual rate : every student can learn at his appropriate rate.
- Amelioration of pedagogical methods : teachers benefit of environment providing sophisticated LCS to produce contents of high quality.
- Permanent availability of courses : teachers invest once in course production, furthermore they concentrate in their main task (i.e. teaching, helping and tutoring students.)
- Flexibility of teaching schedule : the constraints of scheduling traditional teaching and training are eliminated.

However, the analysis of professor questionnaire shows that this new teaching mode needs more efforts from professors, since, in addition to the initial efforts of the content creation, professors spend a lot of time to follow students up such as replying to e-mails, which sometimes can be very numerous, or correcting evaluations. Furthermore, we plan to generalize this experience to teach more courses with this method. We have already trained many colleagues in numeric pedagogy, in particular language teachers and they already started the production of their courses.

III. RESEARCH ASPECT :

A. Introduction

To our knowledge, actual platforms are systems that benefit and exploit new opportunities of Web technology and networks becoming more and more efficient and preferment. Those systems are focused on pedagogic aspect of training and teaching (creation and diffusion of courses, preparation of exercises, …) and the use of communication tools to teach or assist students. However, the most of those systems are unable to detect the level of students, their weakness and difficulties they meet. Furthermore, they are unable to react with students and to propose to them solutions to fix their problems. This is certainly due to the evaluation systems used in most e-learning platform which just permit the student to do interactive exercises of kind QCM or associations or, in the best case, open questions that he has to do and submit to the teacher.

In fact, we believe that efficient use of new technologies of information and communication for learning and teaching needs more than a preferment system which gives its users technological tools [DL00]. It needs reactivity to be adapted to the new situations of learning. In this context, the object of our works is the design of techniques, approaches and tools able to grief *intelligence* in e-learning systems to guaranty their best results. Particularly, the reflections are focused on these points:

- Automatic detection of student level (before e-formation)
- Detection of particular student weakness (during the e-formation) after the analysis of his answers to exercises and pretests and eventually the possibility to propose to him an adequate performance program.
- Individualization of student formation program.

B. Architecture of our system

Our vision of such system is mainly based on the elaboration of dynamic questionnaire generator to compute student level. This generator performs calls, at any step, to a ***semantic analyzer of answers*** to decide the next question to propose. The level computed will lead afterward to generate automatically, for every student, an appropriate training program.

This vision affects the conception of courses and requires a new approach of structuring the training.

To illustrate this approach, let us consider as example the learning of a language during an university program. Two questions can arise:

1) Must we offer the same training program to a public with different cognitive levels?

2) Must we require a student with an important initial background to pursue all the training program?

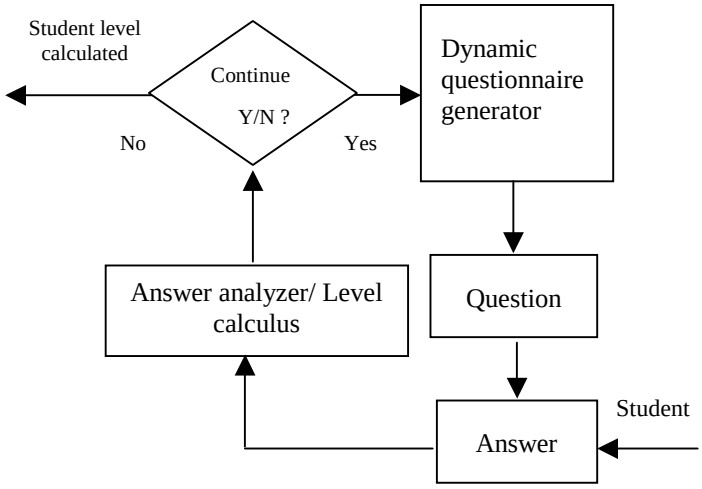

Fig. 6. Architecture of the generator of questionnaires

Answer to those questions depends on mode of education: In classical mode, answer is affirmative because of geographic, temporal and human constraints. In e-learning mode, it can be negative if one has a system considering the profile of the

student. Indeed, according to our approach, the course of language must be structured in constituents or modules (example, structured in: grammar, spelling, conjugation and vocabulary). Every module or constituent must be structured by level of increasing difficulty (for example, structured in level A, level B, level C and level D).

At the beginning of the training, the student must answer a questionnaire to compute his level in every module. Then according to the result, the system will suggest him an adequate program. (For our example, system has, in theory , 4^4 possibilities of training program).

The generated questionnaire can be different from a student to another because it depends on answers of every question.

The general principle of functioning of the system can be schematized by the following algorithm:

```
FOR every module / constituent DO
Current level : = initial level (level A)
   If student has current level + 1 then
      Current level: = current level 1
   Else
      return current level
      Exit
   Endif
End For
```

C. *Semantic analyzer*

As mentioned above, the key step of our system depends on the analyze of student answer. Therefore the answer analyzer must be enough smart and reactive to recognize the meaning of the answer and to compare it with the answer of the professor saved in advance. Generally, understanding a text is a process which is mainly based on the representation of the knowledge of the subject. In the literature, different formalisms of representation - i.e. based on proposition [KIN 78], on scripts [SCH 77]- were proposed in order to let possible a simulation of the meaning. Most of these formalisms are partial and do not give a satisfactory result. Recently, the model LSA [Lan 97] was proposed to represent on a vast space the knowledge corresponding approximately to those of human subjects.

1) *Latent Semantic Analysis (LSA)*

LSA for latent Semantic analysis is a theory and a method for extracting and representing the contextual usage meaning of words by statistical computation.

LSA relies on large corpus of texts to build a semantic space by considering the number of occurrences of each word in each paragraph by means of a factor analysis : Singular Value Decomposition (SVD). SVD is a mathematical decomposition technique. For more details see [LAN 98].

For instance, the word bike occurs generally in the context of handle bars, pedal, ride etc. Therefore, if a word like bicycle occurs in a similar context, the two words will be considered close to each other from a semantic point of view. Their corresponding vectors in the semantic space derived by SVD will be also close to each other.

This method is quite robust : two words could be considered semantically close although they don't co-occur in texts. In the same way, two documents could be considered similar without sharing words.

Those similarities estimations derived by LSA are not simple contiguity frequencies, co-occurrences count or correlation in usage, but depend on a powerful mathematical analysis that is capable of correctly inferring much deeper relations.

Referred to [LAN98], LSA produces measures of word-word, word-paragraph, paragraph-paragraph relations that well correlated with several cognitive phenomena involving association or semantic similarity. We, also, note, for example, that LSA has been assessed as:

- a predictor of query document topic similarity judgments
- a simulation of synonym tests as TOEFEL (test of English as foreign language)
- a simulation of human choices on subject matter multiple choice tests

However, LSA has some limitations. It doesn't consider:

- the word order
- the syntactic parses
- the morphologies
- the logic relations….

Example 1.:

Let consider the two following sentences:

(1) the weather is beautiful but I have to work
(2) I have to work but the weather is beautiful

With LSA the two sentences will be represented with the same semantic vectors (fig. 7.) because for LSA the words like I, to, but … are ignored and the word order is not take in account.

Sentence to Sentence Coherence Comparison Results
The submitted texts' sentence to sentence coherence:

COS	SENTENCES
1.0 0	*1:* The weather is nice but I have to work. *2:* I have to work but the weather is nice.

Mean of the Sentence to Sentence Coherence is: 1.00
Standard deviation of the Sentence to Sentence is: 0.00

Fig. 7. Comparison of two sentences similarity, This comparison is done on-line by http://lsa.colorado.edu/

Nevertheless, what we need, in addition to the semantic similarity, is to consider the argumentation of sentences, specially as we have to analyze student answers that generally use many argumentation. The Theory of Argumentation Within Language (AWL) may mitigate this incapacity.

2) Theory of Argumentation within language

The theory of argumentation within language (AWL) has been concerned with the analysis of the "argumentation articulators" such as nevertheless, therefore, but, little, a little...

When those articulators appear in utterances, they impose on constraints on the argumentative movement. This movement is based on gradual rules of inference denoted by "topoi" [BDR95].

Topoi are the guarantors of the passage from the argument to the conclusion.

Topos (singular of topoi) is:

- presented as general: in the sense that the speaker implicates that the topos holds for other situations. It is not particular for the situation where it is used.
- Presented as shared: in the sense that the speaker considers that the topos is accepted at least by the audience.
- Gradual.

The canonical form of the topos includes two argumentative scales: the argument (antecedent) and the conclusion (consequent).

Each scale is marked on "plus" or on "minus" from which the next topical forms are concluded:

// + P , + Q//
// - P , - Q//
// + P , - Q//
// - P , + Q//

If we believe // + P , + Q//, we necessarily believe // - P , - Q// and in the same way for (//+ P , - Q// ; // - P , + Q//)

To illustrate the presentation above , let us consider the example 2. :

(1) The weather is beautiful but I have to work.

The antecedent uses a topos such as "plus weather is beautiful, plus we want to go out//, the conclusion uses a topos such as //plus I have a work to do, minus I go out//.

The use of "but" in the utterance influences its argumentative orientation and the all utterance orientation is that of the conclusion.

Let now consider the two sentences of example 1. According to the AWL, the two sentences have opposite argumentative orientations. Indeed, for the sentence 1, if the antecedent uses topos like //+beautiful weather, + outing// and the conclusion uses topos like //+work, -outing// then the presence of "but" imposes that the sentence have the argumentative orientation of the conclusion i.e. "-outing".

However, for the sentence 2, and with the same reasoning, its argumentative orientation is "+outing"

To end this illustration, we note the importance of "but", in the sense that it imposes the argumentative orientation of the sentence.

3) Our approach

Now and after a brief presentation of LSA and AWL, we conclude that, first, LSA squares with our approach because it simplifies the representation of the meaning in the sense that the semantic information is directly derived from the co-occurrence of words in a corpus of text, there is no need to use semantic networks or logic formulas. However this simplification causes some limitations, such shown by the examples above. Second, when responding we argue, in the sense that the sentence transports argumentation which must be taken in account. This argumentation can be represented by AWL. Finally, using AWL with LSA to analyze the student answer is a way to reduce the limitation of the later model and produce a system nearing the human model.

In practice, to compare the answer of the student to that of the professor we first proceed by LSA to calculate the semantic nearness of the two answers. If the result is satisfactory (the two generated vectors are close) we calculate their argumentative orientations by AWL in order to decide the correctness of the student answer.

IV. CONCLUSION

In this paper, we have presented works done by the team of e-learning of the ESSTT. Those works concern both pedagogy and research. Particularly, we have presented the evaluation of the pilot experience of e-learning. The experience is very promising and we plan to generalize it for other courses, in particular, languages courses. In the second part of this paper we presented our research works concerning the intelligent e-learning system. This later is based on the combination of two known approach :LSA and AWL. We have already started the development of a prototype for it.

REFERENCES

[Ab99] N. Abida, Business case : tele-learning in Tunisia, workshop TIWSS'99, Tokyo, Japan, Octobre 1999.

[BDR95] S.Bruxelles, O.Ducrot, P.Y. Raccah, Argumentation and the lexical topical fields, Journal of Pragmatics 24 (1995), 99-114

[CJ02] H. Chorfi and M. Jemni, e-learning in Tunisia, state of the art and perspectives, Second Conference JTEA 2002, Sousse, Tunisia, Mars 2002.

[D99] P. Dessus, où va la recherche en éducation? Analyse Factorielle de résumés de communications aux biennales de l'éducation et de la formation, in Année de la recherche en sciences de l'éducation, 6, 201-219, 1999

[DL00] P. Dessus, B. Lemaire and A. Vernier, Free-Text Assesment in Virtual Campus, Proceedings of CAPS'2000, Paris : Europia, 13-14 december.

[D01] P. Dessus, Construction de connaissances par exposition à un cours avec LSA, in Cognito, 18, 27-34

[Je00] S. Jean, PEPITE : un système d'assistance au diagnostic de compétences, PHD Thesis University of Paris VI, January 2000.

[KS99] N. Kustcher and A. ST-Pierre, Les technologies pédagogiques et le Web: un guide pratique pour l'utilisation des NTIC dans un contexte d'apprentissage, Vermette editions, Ottawa, 1999.

[LAN98] Landauer, T.k., Foltz, P. w., Laham d. An introduction to Latent Semantic Analysis, Discourse processes, 25, 259-284

[LMSN01] B. Lemaire, M.Bianco, E.Sylvestre, I.Noveck, Un modèle de compréhension de textes fondé sur l'analyse de la sémantique latente, In H. Paugan-Moisy, V. Nychess, J.Caron-Pargue (Eds). La cognition entre individu et société (Actes du colloque de l'ARCO), Hermès, 309-320

[P00] Person, Graesser, Harter, Mattews & tutoring research group (2000), Dialog move generation and conversation manager for Auto Tutor. ITS 2000 ^roceedings of the workshop on modeling human teaching tactics and strategies. Montreal, Canada

[R85] P.Y. Raccah, Argumentation , Sémantique et Pragmatique, Cognitiva 85, Juin Paris

[R89] P.Y. Raccah , Argumentation et inférence implicite. Actes des journées intelligence artificielle et cognition, Saint Riquier

[R90] P.Y. Raccah, Signification, sens et connaissance: une approche topique :Cahiers de linguistiques françaises n°11.