SMARTNotes : Semantic annotation system for a collaborative learning

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Abstract

Creating situations that promote collaboration between learners and/or their tutor is generally based on traditional communication tools. These are an important means to exchange ideas among learners, validate and consolidate their learning. However, we note that the large volume of messages exchanged between students and the tutor generates unwanted noise that can cause problems of disorientation for the majority of learners and cognitive overload.

Through a solution based on the use of annotations as a support for collaboration, we sought, first, to stimulate interaction and facilitate collaborative activities between learners and their tutor in an activity of understanding of a distance-learning course. Secondly, we have proposed to create connections, through automatic annotations, linking parts of the course to the most relevant messages posted in a discussion forum. The degree of relevance of these messages is based on a customized classification according to the profile of the learner and the objective of the course, as well as the integration of a semantic search done by applying a thesaurus to the LSA method.

Keywords: *Annotation systems, collaborative learning, discussion forums, messages classification, Semantic Web, Latent Semantic Analysis, LSA.*

1. Work context and problematic

On the basis of the logic of classical training, where the learner who wishes to understand the concepts of a course, taking full advantage of the discussions that take place in the classroom to dispel ambiguities and/or more detail on these concepts, the e-learning solutions have encased the training content of technological tools of communication. These systems gather in one place all the necessary tools to learners and tutors to follow learning activities. These tools enable communication (e-mail, forums, chat, etc...), share resources and files (shared bookmarks, virtual libraries, etc.), and even offer distance courses (the case of videoconference session, etc.)[1].

These tools are an important means to conceal the feeling of loneliness within the learner, and encourage interaction with the tutor and peers, this allows him to have/provide support of/to other learners [2].

However, this multiplicity of tools for communication and information sharing, was not without its drawbacks, the fact that distance training often takes place in asynchronous session (the learners are not obliged to follow courses at the same time), usually when the student logs in to the online learning platform, he is faced with a large number of messages that emerged in an exponential and uncontrolled way in the communication spaces, during its disconnection [3].

Generally we see that the important number of messages exchanged between students and tutor to generate unwanted noise that is proportional to the number of participants [4]. Read all that was exchanged in these different sources of information becomes a difficult and harmful task. It can, therefore, lead to problems of disorientation for the majority of learners and induce cognitive overload.

Also searching for information in these environments is a difficult task that requires more patience, the learner finds it difficult to distinguish the types of messages and know their level of educational importance (personal exchanges, administrative exchanges, discussions on the content, group exchanges, etc).

In addition, a need for support is often felt during the progress of the learner in understanding the course[5], the fact that the messages exchanged between learners relating to parts of the course are scattered in various communication spaces (mail, forum discussion, chat, etc.) and so set outside course document, establishing a link between the messages exchanged in these different knowledge bases and content of the source course of these exchanges, generally goes through external references to the course document. The learner finds it difficult to establish the connections between the messages produced mainly in the discussion forums and electronic mail, and the parts of its course. This tends to make the learning process much more cumbersome, inducing cognitive overload for the learner.
The learner finds himself lost in this rich mine of information but unfortunately not easy to handle, pushing him not to use it properly as a source to supplement and enrich his learning process.

In this article we present the specifications of our annotation tool called SMARTNotes to support the learner in learning activities, and we look at the problem of linking the digital course materials and exchanges produced through communication tools, particularly discussion forums. We propose an approach to automatically generate annotations on the course document leading to messages produced through the communication tools. This will allow on the one hand to remain open on the choice of communication tool within the constraints of the learning activities and also to avoid the learner the effort to link between the course document and exchanges of posted messages in the bases of these communication tools.

2. Specification of SMARTNotes annotation system

Because communication tools, find their relevance only if they are used in a context providing the best possible interactions with respect to exchanges around the course content, we propose a solution that incorporates the messages produced by learners and the tutor in this latter.

It was inspired by the practice of annotation of paper documents, which is a practice frequently used by readers to write personal comments on its margins [6] [7]. This activity allows annotators to express their views, to build a stable and written memory of the passages that they annotate [8].

The annotation on the Web offers more to the reader the opportunity to share his notes. Thus, the person consulting an annotated document can acquire annotations attached to this document. This allows asking questions, giving advice and discussing problem solving in group, by using the annotations. The learner can have a complete and an enriched overview of his course document containing its messages (advice, questions, answers, references, etc...), and those of others attached to their corresponding parts in the document. This will save the effort to the learner to make associations between his notes (and those of his colleagues), and parts of the course sources of these interactions.

It is in this direction that we have proposed a collaborative annotation system, we have called SMARTNotes. This system aims to provide learners (and tutor) with support tools for fostering collaboration through the course document. The learner can interact, validate and enrich his course by the notes generated during the collaboration with his tutor and his peers.

2.1 Definition and objective of the annotations

The annotation is an action performed by setting a mark on an object. It is a sign of mental state that the reader gets about the annotated item [7]. In our context, the latter representing the target to which the annotation is linked, can be a collection of documents, a document, or any part thereof (paragraph, sentence, word, image ...), or even another annotation.

Studies on annotations [5][9][10], have shown that annotations made in a shared document can be used either by the annotator himself for personal use (support for active reading, customization, argumentation, etc.), or a consultant of the annotated object, be it a human (ownership, guidance and counseling, discussion and collaboration on the document, etc.) or a machine (automatic generation of abstract indexing for extensive research, tracking interactions, etc.).

2.2 Collaborative annotation systems

Several annotation systems have been developed, some addressing common issues and others specific to them. There are two types of field of use of such systems, either to index web resources to facilitate research, or to facilitate communication in an activity of understanding a document or the completion of a joint work involving several actors. Among these systems, we can mention, Annotea which is an experimental project of consortium W3C aiming to develop an environment of shared and collaborative annotation [11]. By using open standards of W3C, in particular RDF (Resource Description Framework), it arises as an objective to promote interoperability between applications that exchange annotations in the form of metadata. CoNote is also a collaborative annotation system developed at Cornell University [12]; it focuses on rights of access to annotations for a group of people who share a document. The annotations in the Yawas system are dedicated to the automatic and customized classification of annotated documentation. It shows that the classifications obtained

through annotations are more accurate than those obtained using the full document [13].

2.3 SMARTNotes collaborative annotation tool

In our SMARTNotes system, the annotator (especially a learner) interacts with the document he consults ; he is actively involved in enrichment. He is no longer seen as a simple passive reader, but he becomes more of a reader / a writer of the document; he completes it by his own understanding by annotating it as and when he progresses in reading. These notes serve as a means of locating relevant information and clarification in the form of comments.

2.3.1 The annotation representation model

One of the basic elements in the establishment of an annotation system is how to organize information about the object in the annotated document to be manipulated and implemented without any difficulty.
We were inspired by the model proposed by the W3C consortium which is an annotation as a set of metadata (attributes of annotation) and the body of the annotation (the content of the annotation). Properties induced by this model are, firstly, the opening notes to share with other systems that meet this standard and also the possibility of the scalability of this model to support new annotation types.

Metadata are defined as an RDF schema. This latter represents a set of specifications aiming to standardize the modeling of annotations to ensure interoperability between applications exchanging metadata.

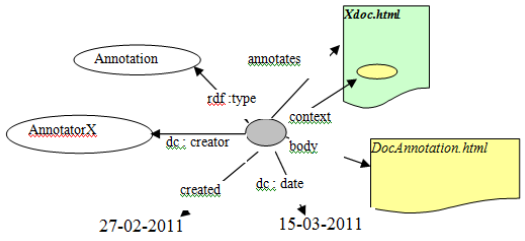


Fig. 1 RDF model of an annotation proposed by W3C

The annotation shown in the figure above was created on 27-02-2011 by the AnnotatorX, and subsequently amended on 15-03-2011. It is associated to the context located in the Xdoc.html document and its content is put into the document DocAnnotation.html.

2.3.2 Definition of semantic annotation

The formats used to annotate a document differ from one annotator to another; each makes his annotations according to his own semantics. This can lead to an overload in reading annotations; a learner cannot know the subject of an annotation (question, answer reference, etc.) unless he reads its contents. Also, the tutor has to read the content of any posted messages if he wants to recognize the learners with learning difficulties (ask more questions) from those who are not (offer more responses).

We feel it is extremely interesting to type annotations in SMARTNotes we defined taxonomy of acts of dialogues adapted to the type of interactions that the annotator can do. It is proposed to extend the RDF model to also support the type of the annotation. We categorized all the annotations according to their purpose and their semantics. Each category is associated with specific types expressing the subject of the action of the annotator.

When an annotator (learner/tutor) decides to create an annotation, the system asks him via a semi-structured type of annotation to be set. This technique did seem to us a little heavy for the annotator, but it is most relevant in the field of communication. On the one hand, the fact of assigning a type to annotation leads the annotator to ask about the specific purpose of this [14]. On the other hand, this semantization will enormously facilitate the automatic analysis of the behavior of the annotator in his group [15].

Category	TYPE	DESCRIPTION
Highlighting	Important	Allows emphasizing the selected part to give more value compared to the other parts of the document. The annotator can explain, with a comment, the cause for which he judges that a passage Highlighting is important.
	Useless	Allows to cross out the selected part to indicate that it is useless. The annotator can explain, with a comment, the cause for which he judges that a crossed out passage is useless.
Consign	Advice	The annotator can propose advice in the form of annotation to direct another annotator. For example, a tutor (even a learner) can give advice to another learner who is facing some learning difficulties.
	Explanation	Allows to add an explanation
Conversation	Question	Allows to ask question
	Answer	Allows to answer a question
	Discussion	Allows to open a discussion forum which can be carried out between two or several annotators on an annotated object. An annotation of the discussion type is a made up

		of annotation which can include an annotation of the question type, answer, advice, explanation.
Indication	Reference	Represents a reference to another resource that can be an internal passage in the document, an annotation on the document or to an external document. This allows the reader to refer to a reading in relation to the passage annotated.
	Alert	allows the annotator to plan future temporal actions (annotation performed by the system according to a given date) and non-temporal (type of annotations to read).

Table 1. The categories and types of annotations in SMARTNotes

2.3.3 Annotation based discussion forums

We have proposed in the first version of SMARTNotes collaboration support between users through chat rooms based annotation. The annotator can post a message as a comment, question and / or response by annotating annotation. The conversational type of annotation is then presented as a discussion thread. The annotations are attached together and presented as a tree structure similar to the classic discussion forums. The advantage of this approach is that the context of the discussion-forum annotation based is defined by default by the content of the annotated part. This allows for even easier and direct exchange on the parts of course document.

3. Automatic semantic annotation of course documents

As we have previously reported, the communication tools have an important place in an e-learning platform; they have a very important role in stimulating interaction between the learners and their tutor. Each tool has its place in the learning activities according to many factors: objectives sought, characteristics of the target audience, time and technical constraints. For these reasons, we found it beneficial to create links between our SMARTNotes system and other communication tools. We thought it better to integrate on our system the ability to generate automatic annotations filed on the course document leading to the messages produced through these tools. This will allow on the one hand to remain open on the choice of communication tool according to the constraints of the learning activities and also to enable the learner avoid efforts to make the connections between the course document and exchanges of posted messages in the bases of these communication tools.

To do this, we proposed an approach based on two steps: the first allows a semantic classification of posted messages through the communication tools. This classification is based on: (1) the creation of a thesaurus based on the interests of the learner and the objectives of the course, (2) adapting the LSA method (Latent Semantic Analysis) to group the posted messages with thematics that are semantically close.
The second step of our approach is to automatically generate annotations linking parts of the course document to the messages exchanged in discussion forums in connection with these parties.

4. Semantic classification of posted messages in a discussion form

To facilitate the search of exchanged messages, the majority of communication tools use a classification based on keywords chosen by the learner; the results returned are generally independent of the conceptual intentions and areas of interests of the latter; this makes them in most cases ineffective and unintelligible. These problems are increasing on the one hand with the volume and variety of messages exchanged in discussion forums and also because of the synonymy and/or polysemy problems.

We propose to include in SMARTNotes a semantic search process delivering messages according to the most appropriate interests of the learner and the objectives of the training undertaken. This research does not require direct involvement of the learner. All relevant information to the search query are implicitly acquired from the profile and training objectives set by the author of the course.

As mentioned earlier, the important volume of messages exchanged through the communication tools often generate unwanted noise, making their reading a difficult and non practical operation. The purpose of our work is to better exploit its messages for an instant support to the learner in his activities of construction of knowledge through the course document.

4.1 Support for the learner profile in the classification of messages

The user profile is the subject of attention in several areas in particular that of education. It is represented by a set of educational and general information on the learner that are useful to establish an adaptive learning. The specifications of standard models have proposed structuring the information into categories: identification, access, relationships with others, etc.. In this article, we are interested in the IMS-LIP (Instructional Management Systems Global Learning Consortium for Learner Information package) standard, which offers a rich profile model used in most current systems of learning, and having the category "GOAL" describing personal learning objectives and aspirations of the learner.

We then propose to exploit this category to achieve an automatic classification of messages exchanged between learners, which will be adapted to the learner profile.
For a better classification of messages, we also add to the information in this category keywords associated with learning objects. These keywords are defined by the author of the course during the creation of the latter. We have adopted the model proposed by LOM (Learning Object Metadata) is a de facto standard and widely used. LOM provides the element of "Keyword" in the category "GENERAL" dedicated to store the keywords related to a learning object.

All keywords deducted of "GOAL" of the learner profile and the "Keyword" element of learning objects (the course document), is the query we will use to search for posted messages in the discussion forum.

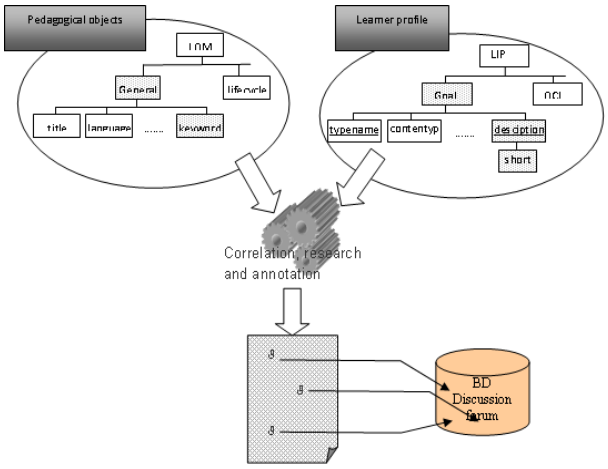


Fig. 2 Process of automatic generation of annotations

4.2 Semantic classification of messages based on LSA

Instead of searching the messages based solely on the terms set by the learner profile and keywords associated with learning objects, resulting in most cases in restrictive findings because of synonymy and polysemy problems, we propose (a) to extend this research to the terms semantically related to them by referring to a thesaurus. (b) classify messages by using the LSA method that will be completed by the measure of similarity of messages based on the application message [16].

4.2.1 Process of creating the thesaurus

The thesaurus is as an instrument of control and structuring of the vocabulary; it contributes to the consistency of indexing and facilitates the search for information to modulate the rate of recall and precision in the identification [17].

We then created a thesaurus in the area of information technology from the whole corpus of messages in different topics (e.g., system, language, technology, etc.).

To build our corpus, we did a search on each message to select the terms which include more information. As a result, we have created the semantic relationships (hierarchical, equivalence and association) between these terms.

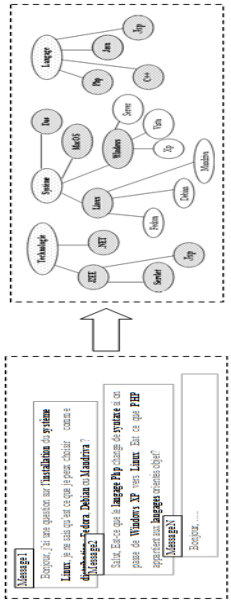


Fig. 3 Result of the process of creating a thesaurus of IT field

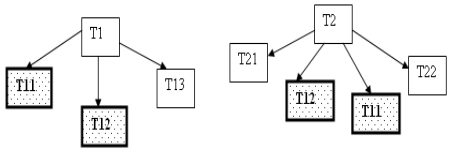
At the end of this process, we obtain a global organization of all the terms of our corpus according to semantic relationships that will generate the basic thesaurus for our research.

4.2.2 Classification of messages by using LSA method

The Thesaurus, designed in the first stage, will be applied in the construction phase of the lexical table (Terms / messages) that will precede the application of the LSA method (Latent Semantic Analysis).
The LSA is a method to determine similarities between documents; a document can be a text, a paragraph or even a sentence or a word [18]. For this, each message is represented by a vector m= (d1, d2, d3, …, dn) called lexical profile in which the jth component dj represents the weight (or importance), the message m, the indexing term tj associated to the ith dimension of the vector space. Then we proceed to the normalization of this matrix [19].

For successful application of the thesaurus during the construction phase of the lexical table we have adopted an approach which is to include more keywords mentioned by the user, the specific terms associated with them via the thesaurus and common to them while avoiding repetition.

T1 and T2 two terms mentioned by the user. T11, T12 T13, are terms specific to T1 and T21, T12, T11, T22-specific to T2. We note that T11, T12 are common to T1 and T2.



The generated lexical table as follows :

	Messages
T1	Occurrences of terms of each message
T11	
T12	
T2	

Table. 2 Lexical table includes all the terms in semantic relationships with keywords

For all the messages, we take into consideration all those coming from our basic message and the query keywords that will be considered also as a message. To classify the messages we use the LSA method that will be completed by the similarity measure of basic messages with the message request. To do this, we chose the cosine which is a simple measure in terms of computation and accurate in terms of results compared, for example, to the Euclidean distance and the scalar product [20].

Following the first approach, the overall architecture of our system can be summarized as per the following diagram:

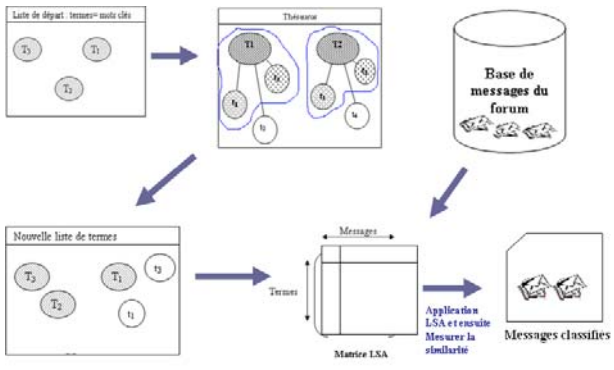


Fig. 4 General architecture of semantic classifier module

The application of this approach shows that the research carried out by applying a thesaurus to the LSA gives a more relevant result than that obtained from the application of the LSA only. The results obtained return messages whose context is one of the themes of the terms introduced by the user without being given in the latter [19].

5. The SMARTNotes architecture system

5.1 The annotation system architecture

The standard architecture of a system of annotation is primarily based on the notion of intermediary that provides the interface between the client and the Web server [13], [23]. It is responsible for processing any transaction on the annotations between client/server and consists of four complementary modules to ensure the execution of the annotation:

- The **Interceptor** is solicited at each request sent by the client browser. If the application requests the loading of a page, the interceptor sends it to the Web server, get the result, then needles is to the Composer module.
- The **composer** is responsible for include the annotations extracted from the annotations base (if any) in the requested page and returns the result to the Interceptor module. The latter returns the annotated page to the client so that it can finally be loaded by the browser.
- The **Annotation Management module** is called by the interceptor to update the database of annotations on requests from the client browser to do so.
- The **User Management module** provides the management of users and access rights to the annotations.

We have distinguished three types of implementation of the architecture of an annotation system according to the position where the intermediary is installed:

- The first architecture proposes the intermediary to the Web server. The proposed annotation features are limited to web pages published on it
- The second architecture places the intermediary on a particular server set independently of the client and Web servers. This proxy server follows the standard pattern of an annotation system; it acts as an interface between the client and Web servers and manages pages with annotations on its base [24]. Among the weaknesses of this architecture is that we mainly found the response time slow. All tasks are performed by the proxy server, the search for the requested page, the extraction of annotations associated with it from the base, the integration of these annotations on the page, and return the response to the browser applicant, make of this server a major choke point.
- In the third architecture the intermediary is put near the client, as a plug-in or external application (eg an applet). The aim is to enrich the browser functions to manipulate the annotations of a web page. This architecture has more advantages than the previous two: ability to annotate web documents stored locally, more flexibility and control of interactions of the annotator and avoiding the bottleneck at the server. However, opposed to this, it remains dependent on the

type of browser used and the possibilities of sharing annotations and collaboration on web documents are painfully managed.

5.2 Main components of SMARTNotes system

In SMARTNotes, we propose an architecture based on an intermediary divided between the client and server. The first part is set at the browser as an extension, allowing the user to annotate a document, when loaded by the browser, without using the annotation server. The interceptor module provides communication between the client and the server; you can either retrieve the annotations associated with the document loaded from the server or to transmit the updates made. The composer module is also placed on the browser; it is based particularly on the DOM and XPointer technologies to include annotations in the web page being loaded.

The second part of the intermediary server is placed on the annotation to intercept client requests and manage the annotations present in the base. The semantic classification module of the messages posted in the discussion forum enables to deliver the most appropriate messages according to the interests of the learner and the objectives of the training undertaken.

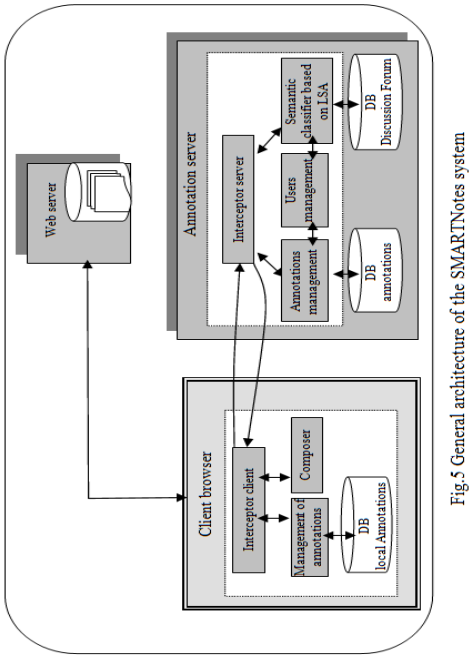


Fig.5 General architecture of the SMARTNotes system

This architecture has several advantages, namely:

- Respect of confidentiality: providing the ability to save annotations locally with the client.
- The off-line annotation of documents: the integration of the intermediate level clients can annotate a document (local or remote after the download on the browser) without having to connect to the server annotation. The annotator can make a backup of annotations locally or export batch annotation on the server; this will also avoid the problem of the bottleneck at the server level annotation.
- Sharing of annotations and collaboration on the document in a simple way: they are based on export operations and synchronization between the server and annotation client. Each time the server intercepts an update of a page, it sends a message to the client connected to the server and logging on the same page. The automatic refresh of the page is done on the client terminal only after confirmation of the user warned.
- Response time very small: the set up of the composer and the manager of annotations at the level of client allows on the one hand to manipulate the annotations of pages with very low response time. Secondly, reduce the frequency of use of the annotation server as backup and search annotation on its base. And therefore also have long response times on the server annotation.

5.3 Processus of Integration of annotations in the course document

In SMARTNotes, communication between the client and the server is based on an exchange annotation XML. We have defined a database link associating the content of the annotation, which is stored in the annotations or discussion forum, and the corresponding part of the course. This solution enables the reader to view the document associated with annotated annotations in a transparent manner and unchanged the source document.

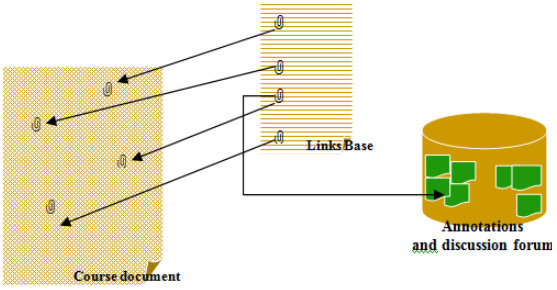


Fig.6 Base of links joining the basis of exchange information to the course parts

The connecting links between the base of exchange information and to the document to be annotated are put into a database of links regardless of the course document which solves the problem of copyright of the course. Thanks to the XLink technology which offers new mechanisms making hypermedia documents more flexible, we defined this XML document called "basic links" without text links that are totally separated from the source document.

6. Conclusion and perspectives

In this work we have presented barriers that a learner may face in the misuse of traditional communication tools in an activity of understanding of a distance-course. In particular, the large volume of messages posted in these

areas can lead to disorientation for the majority of learners and cognitive overload. We have proposed to put the hypermedia course documents in a broader dimension to centralize much more interaction and exchange of ideas for successful learning. Through a solution based on the use of annotations as a medium for collaboration, we sought, first, to stimulate interaction and facilitate collaborative activities between learners and their tutor in an activity of understanding of a course. Secondly, we have proposed to create connections, through automatic annotations linking parts of the course to the most relevant messages posted in a discussion forum. The level of relevance of these messages is based on a customized classification according to the profile of the learner and the objective of the course as well as the integration of a semantic search done by applying a thesaurus to the LSA method.

The design of the functional architecture of our annotation tool has been defined; it meets a number of requirements such as independence from the platform hardware / software, interoperability, scalability to support other types of annotations. Also, in order to verify the feasibility of our proposal based mainly on XML technology, unit tests validation were successfully completed. The application of our approach to semantic classification on a corpus of messages posted through a discussion forum of the MOODLE platform has shown relevant results with the LSA method.

We are now in a period of experimentation with our system and we plan to include a recommendation system that draws in the documents annotated by learners and tutors, and automatically offers educational resources for active learners without having to explicitly request their feedback.

References

[1] N. ABGHOUR, "Schéma d'autorisation pour les applications réparties sur Internet", Thèse de l'Institut National Polytechnique, Toulouse, Rapport LAAS, 2004

[2] Henri, F. & Lundgren-Cayrol, K « Apprentissage collaboratif à distance, téléconférence et télédiscussion.» Rapport interne n°3.Montréal, Canada; Centre de recherche LICEF, 1996.

[3] D.Bouzidi , R.Ajhoun, A.Benkiran, "The use of the annotations in a collaborative activity of reading an online hypermedia course document". IEEE 1-4244-0406-1, 2006

[4] Marc Walckiers and Thomas De Praetere « L'apprentissage collaboratif en ligne, huit avantages qui en font un must ». Vol.2 Distances et savoirs 2004, ISSN 1765-0887.

[5] R.Elouahbi A.Nassir and S.Benhlima, "Design and implementation of adaptive sequencing based on graphs", 11th International Educational Technology Conference, Turkey, 2011, p 233-238.

[6] C. Marshall, "Annotation: from paper books to the digital library ", In Proceedings of DL '97, 1997, pp.131-140.

[7] M.Veron « Modélisation de la composante annotative dans les documents électroniques » Rapport de stage du DEA Représentation des Connaissances et Formalisation du Raisonnement, UPS-IRIT, Toulouse, Juin 1997.

[8] D.Bouzidi, « Collaboration dans les cours hypermédias du système de télé-enseignement SMART-learning », Thèse de Doctorat, Spécialité Informatique, Ecole Mohammadia d'Ingénieurs (EMI), Université Mohammed V-Agdal, Rabat, 2004.

[9] J.J Cadiz, A.Gupta, J. Grudin "Using Web Annotations for Asynchronous Collaboration Around Documents", Conference on Computer Supported Cooperative Work (CSCW2000), Philadelphie, Pennsylvanie, USA, 2000.

[10] L. Denoue, « De la création à la capitalisation des annotations dans un espace personnel d'informations ». Thèse de doctorat (PhD), Université de Savoie, Octobre 2000.

[11] M.R Koivunen, "Annotea : Applying Semantic Web Technologies to Annotations", in "Semantic Web Kick-Off en Finlande, Vision, Technology, Research and Applications", HIT Publication, Hyvonen Eero (ed), p.213,226, 2002

[12] J.Davis and D.Huttenlocher, "Shared Annotation for Cooperative Learning". Proceedings of the Conference on Computer Supported Cooperative Learning, 1995

[13] L.Denoue & L.Vignollet, "Yawas un outil d'annotation pour les navigateurs du Web", IHM'99Montpellier, France, 1999.

[14] G.Sébastien, "Apprentissage collectif à distance. SPLACH : un environnement informatique support d'une pédagogie de projet." Thèse de Doctorat, Spécialité Informatique, Université du Maine, 2001

[15] D.BOUZIDI, R.AJHOUN, A.BENKIRAN, "Les annotations pour un apprentissage collaboratif", JOCAIR'2006, colloque International, France 2006 pp.372-382.

[16] S.LGARCH, D.BOUZIDI, S.BENNANI, "Une approche sémantique de classification de messages d'un forum de discussion basée sur la méthode LSA", WNGN Workshop on Next Generation Network, pages : 3-8, Maroc 2008, pages 3-8.

[17] L.Saadani et S.Bertrand-Gastaldy, " Cartes conceptuelles et thésaurus : essai de comparaison entre deux modèles de représentation issus de différentes traditions disciplinaires ",2000

[18] Y.Bestgen , « Analyse sémantique latente et segmentation automatique des textes » , 2004

[19] G. Salton, « Autoamtic Text Processing – The Transformation Analysis and Retrieval in Full Text Information Systems», 1989

[20] H.Zargayouma « Indexation sémantique de documents XML » Thèse de doctorat, 2005

[21] S. LGARCH, "Une approche sémantique de classification de messages d'un forum de discussion basée sur la méthode LSA", Rapport de DESA, Mohammadia Engineering School, Mohamed V–Agdal University, Rabat, Morocco, 2008.

[22] V.Vasudevan and M. Palmer, « On web annotations : Promises and pitfalls of current web infrastructure». Actes de 32nd Hawaii International Conference on System Sciences, Maui, Hawaii, 1999

[23] I.Ovsiannikov, M. Arbib, et T. McNeill, « Annotation technology». Int. J. Human-Computer Studies, 50 :329–362

[24] E.Desmontils, C.Jacquin & L.Simon, « Vers un système d'annotation distribué », Rapport de recherche n°03-01, Nantes, Institut de Recherche en Informatique Université de Nantes, 2003, 16 p.

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