CREATING RICH COLLABORATIVE LEARNING SCENARIOS: A MODEL DRIVEN APPROACH FOR CONTEXTUALIZING SOFTWARE COMPONENTS AND ELECTRONIC DOCUMENTS

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ABSTRACT

This paper presents our current works that consist in engineering Problem Based Learning (PBL) Environments that make use of didactic documents. The electronic documents that we focus on embed spatial and temporal information in relation with the learning domain.

From a design point of view, our approach consists in making explicit, in connecting and documenting both the specifications of a learning scenario and the electronic documents that it requires. From an implementation point of view, we explain the added value of the tools that we can provide to designers, learners and tutors for dealing with the spatial and temporal information embedded in the electronic documents.

At the end of the paper, our method for analysing documents and activities is exemplified by the Smash Case Study, a PBL situation dedicated to good driving behaviours. From that example, we describe dedicated tools, particularly an e-whiteboard with pedagogical capabilities.

1. INTRODUCTION

Our works focus on the development of Collaborative Problem-based Learning (PBL) scenarios and tools that provide students with resources, guidance and instruction. Our research team emphasizes the role of the designer producing socio-constructivist scenarios which are sequences of phases, tasks and activities including resource discovery, discussion, resource production and feedback. The research work consists in both proposing models and engineering a collaborative PBL environment according to the constraints of a given scenario.

Documents are central elements in such collaborative learning scenarios since they can either represent cognitive resources, proofs of some apprenticeship or some knowledge vector (Laflaquière 2002). To play such a role, documents must fit the educational activity proposed to the learners. In other terms, the “documentary space” of a learner is useless if it is not pertinent with the activity proposed to this learner. This is precisely the problem of trying to reuse documents and resources found on the World Wide Web (web pages, web services, etc) because these documents were created to serve stated communication objectives and by the way require to be reengineered to serve new learning goals.

To address these problems, we promote an application of Component Based Development that consists in engineering educational resources and gluing them to produce a learning environment fitted to a particular learning scenario. Going from a given document towards a didactic document requires a design process that we can compare with the process of going from a non-didactic activity (e.g. driving a car in real conditions) to a didactic activity (e.g. inquiry quest of 11 years old learners trying to explain the reasons of a driving accident) (Balacheff 2004). Thus, our approach consists in making explicit, in connecting and documenting both the specifications of a learning scenario and the « resources » that it requires. Two types of resources are to be finely tuned with a socio-constructivist learning scenario: we try to contextualize and specialise both the software components and the electronic documents that the actors (learners, tutors) will exploit while interacting according to a given scenario.

In this paper, we first present our current works that consist in developing PBL situations that can exploit the semantics of contextualized electronic documents. We then study the problem that consists:

1. In developing techniques and tools to analyse temporal and spatial information extracted from such electronic documents.
2. In exploiting the semantics of such marked documents to tutor learners involved in a PBL situation.

In the third part of the paper, we exemplify our approach for the Smash PBL situation, a learning situation dedicated to the apprenticeship of good driving behaviours. For this learning situation, we developed an e-whiteboard tool that can tutor learners from the information contained in several documents (testimonies of the accident) provided to the learners. We study the information model of this e-whiteboard tool from spatial and temporal points of view. We also describe the technical architecture used to produce this tool.

In the conclusion and perspectives, we present the benefits that we can afford of such an approach both for tutoring the learners and for authoring learning scenarios.

2. COOPERATIVE PROBLEM-BASED LEARNING FROM DIDACTIC DOCUMENTS THAT EMBED SPATIAL AND TEMPORAL INFORMATION

Information Technology is changing the access of knowledge, the process of learning, and the delivery of education and training: several years ago, learning, working and capturing knowledge were disparate and relatively independent activities ; but now these activities are converging to become one since "learning is knowledge in action, a continuous spiralling conversion of tacit knowledge (such as know-how and experience) into explicit knowledge that can be captured, shared with others, diffused within groups, and turned back into new tacit knowledge gained from learning by doing" (Hodgins 2000).

In the framework of such a convergence, learning by doing becomes a key-process of higher-order cognitive skill development including decision-making, problem-solving, teamwork, pattern-recognition and critical-thinking.

2.1. Learning from Cooperative PBL situations

Our works focus on one learning by doing strategy called Problem-Based Learning (PBL). The aim is to develop PBL environments promoting "learning by doing" activities assisted by technological and human coaches that provide the low level and high level support. In our context, the support focuses on mentoring, motivating, creating simulated crises, showing how failures are attributable to poor communication and lack of foresight, identifying and promoting areas in which teams and individuals must make progress.

PBL is different from traditional instructional methods that put the focus on the content: traditionally for each content area, designers divide the topics into small and manageable bundles, and they transfer those to students according to a prescribed lesson plan. In PBL, the focus is on the learner and authentic problems (Norman and Spohrer 1996). Guided by tutors who just take a facilitative role, learners engage in active and meaningful cooperative learning. The object of a PBL activity is an ill-structured problem under study and the expected outcome of a PBL activity is (Miao 2000):

1. Acquiring knowledge and skills that can be transferred to solve similar problems on an individual level.
2. Constructing a shared knowledge and promoting mutual understanding on the group level.

In general, tasks are assigned to different learners who will have different responsibilities for performing various tasks. Learners organized as sub-groups are the active agents who are responsible for the whole learning process; they collaborate with each other by using tools to define problems, to generate solutions, to debate different perspectives, to conduct experiments and simulations, to write reports, etc. The driving force is the problem given, the success is the solution of it, and apprenticeship is a condition of success.
Meanwhile, different members of the community including tutors and experts also divide responsibility in defining and influencing the object of the PBL activity. Pedagogical events raised by learners are used to regulate the behaviours in the interaction among learners, tutors and experts, to use instruments and to measure outcomes. It is noticeable that PBL is not a pure constructivist approach but uses also multiple methods of instruction, among them direct, explicit didactic instruction (Develay 1993), (Moursund 1999).

In previous papers, we have presented a UML profile called the CPM profile. This profile is implemented on top of the Objecteering UML Case Tool to enable designers together describing structural, cognitive and social aspects of any cooperative PBL Situation (Laforcade, Barbier et al. 2003), (Nodenot, Marquesuzaà et al. 2004).
In this paper, we shall describe neither the details of this language, nor its capabilities to transform structural, cognitive and social PBL descriptions into software components embedded in a given Learning Management System (Laforcade and Barbier 2004). In the next paragraphs, we shall rather focus on mapping PBL descriptions with documents in order to provide users (learners, designers) with the cognitive tools that they need.

2.2. Cooperative PBL situations making use of documents that embed Spatial and Temporal Information

Documents are central elements of PBL situations because the learner has to face real life inquiry situations for which electronic documents can serve different objectives:

- Documents are produced by the designer to provide the learners with concrete didactic information detailing fundamental elements and objects of a given PBL situation.
- Documents can be put at learner's disposal: they can be read by learners to consider the problem, to get deeper understanding about the objects of the domain of study proposed by the PBL situation.
- Documents are produced by learners to meet the formal requirements (e.g. "You must write a report that will explain in the manner of a police investigator, the reasons of an accident") of the functional solutions they propose to solve a problem.
- Documents are also interesting by-products which are produced by learners to make and check hypotheses, to share ideas and opinions.
- Documents are also produced / filled by teachers and learners to propose exercises and give answers and feedback.

These examples show the role of documents in Problem Based Learning since they can either represent cognitive resources, proofs of some apprenticeship or some knowledge vector (Laflaquière 2002). Nevertheless, in the latest release of our CPM profile proposed by (Laforcade 2004), documents are not considered as they should: they are treated as *resources* which are *produced* or *used* by an *actor* (tutor, learner) playing a particular *role* for a given *pedagogical activity*. Yet, whereas the CPM profile provides several detailed concepts and tag values to describe cognitive resources such as the mental representations of the learners, the prerequisites of the learning activities, the objectives and post-requisites of these activities, CPM is silent about information embedded in the documents associated with learning activities. Other works in the domain of PBL (Miao 2000) and Computer-Aided-Learning (IMS 2003) do not provide designers with more convenient concepts although the importance of such documents to fully understand and describe the activities and the cognitive tools to put at the users disposal. To explain this situation, we consider that the diversity of available documents makes difficult the job of describing information contents for any type of document. By the way, providing designers with some computer-support to analyse any type of documents and to capture the information they embed is beyond current capabilities of Information technology.

As a consequence, we decided to narrow the field of our documentary investigations to particular documents that embed meaningful spatial and temporal information. Of course, this choice restricts a little our PBL studies to certain domains but from a pedagogical point of view, we consider that most learning situations integrate such spatial and temporal information: PBL situations focusing on learning domains such as geometry, geography, history, applied science and biology can be addressed from spatial and temporal perspectives. Moreover, this choice is also significant from a technical point of view: some of the researchers involved in this work have already investigated the field of computer-support analysis of spatial information embedded in electronic documents and their understanding of the current state of the art leads us to focus on temporal and spatial analyses because other types of analyses are not technologically mature at the moment.
For such documents, our aim is:

- To provide designers with computer-support tools in order to efficiently mark the content of these documents with semantic tags from an in-depth syntactic and semantic analysis.
- To use theses marked documents when describing a PBL situation. To this end, we promote mappings between the concepts describing spatial and temporal aspects of a document and the concepts already available in CPM (social, structural and cognitive aspects of a PBL situation).

The next figure presents a UML class diagram presenting significant information that we want to mark on documents that embed spatial and temporal information.

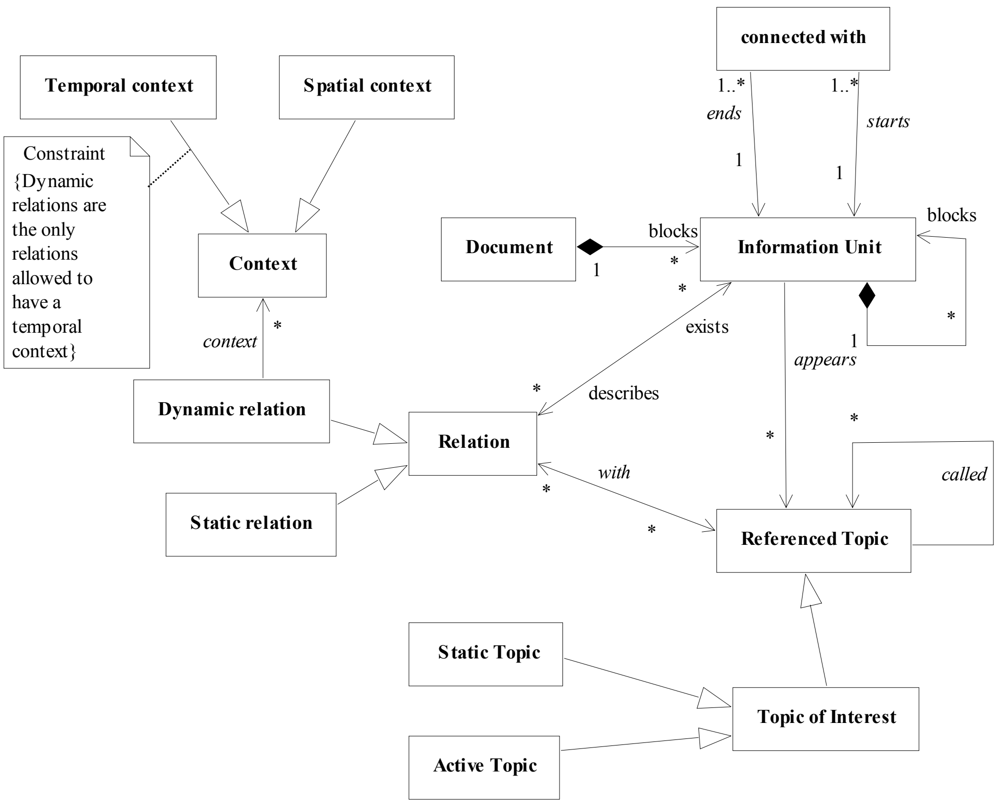

Figure 1: UML description of the marks to be put on documents that embed temporal and spatial information.

In the previous figure,

- A *document* is composed of blocks of *Information Unit*s representing sections, paragraphs, lines, etc. if it is a textual document. Information Units can also represent parts (foreground, background, etc.) of a schema or image if the document is not textual.
- An *Information Unit* provides information about some *Topics of Interest* (in relation with the domain of study) that can be identified under different appellations (e.g. "Mr Brown" could be referenced as "he" or "the driver" in different *Information Unit*s or *Document*s).
- Topics of Interest are either *Static Topic*s (they do not initiate actions but they can be affected by actions) or *Active Topic*s.
- *References of Topics of Interest* are connected through *Relation*s which are either static or dynamic. A *static relation* is timeless in the context of the analysed document (e.g. "Mr Brown owns a red car"). A *Dynamic relation* is always contextualised by time or space (e.g. "the red car crossed Mr Lewis at the zebra" or "Mr Brown was ready to cross the zebra" or "Mr Brown met Mr Lewis after the latter crossed the zebra").

From such marks put on documents in relation with a given PBL situation, we intend to propose cognitive tools to users:

1. Pedagogues and designers need to be able to access (and specialise) the cognitive specifications of the production / co-operation / co-ordination tools. These tools are used within dynamic activities that embed elements and pieces of documents corresponding to the learning process imagined by these designers. Moving from documents to activities and from activities to documents can lead the designers prototyping both documents and PBL activities in a coherent way.
2. At the different levels of the learning scenario (general, group level, cooperative activity, individual task), learners and tutors need tools that promote some "reflection-in-action", some meta-cognitive activities (Schoen 1983): *to-do lists, checklists, table views* can give the actors some feedback enabling them to do some opportunistic productions / co-operations / co-ordinations. These tools can provide
    - Critical mechanisms that can deliver knowledge to actors about the implications of their actions or decisions, about the potential problems of their productions, ...
    - Knowledge support to learners who lack pieces of knowledge about the specific problem that they must face, about the solution domains imagined during the design stage, about the criteria of success.
    - Knowledge support to learners/tutors who need some advice about the learning process they must face within the proposed activities.

We are convinced that such cognitive tools can be implemented from PBL specifications taking advantage of spatial and temporal information embedded in didactic documents. In the next paragraph, we shall briefly present general techniques and tools to automatically mark documents from spatial and temporal points of view. Part 3 will present a case study to exemplify our approach and will discuss the functionality of a cognitive tool implemented for that PBL situation.

2.3 General methods and tools to automatically mark documents from spatial and temporal points of view.

As presented above, approaching didactic documents based on their geographic contents can be important in several contexts. This section is concerned with Information Retrieval (IR) from documents through two aspects: space, time linking some topics of interest i.e. Geographical Information Retrieval (GIR). GIR can be seen as a specialized branch of IR; it includes all of methods and techniques that have traditionally made up the core of IR areas, but in addition deals with any kind of information that has some sort of relation to one or more locations on the earth's surface. Information that has such relationships is often related to a given time (expressed or not).

This section is structured as follows: first we examine the gap between computing and human handling of spatial information and then how this influences the retrieval of textual documents. Next we examine some properties of our textual corpora through the geographical cognitive point of view. Finally, we briefly describe methods and associated techniques to implement tools dealing with such information.

GIR demands designers to handle geographical information in a formal manner. The formal handling of spatial and temporal information is mostly based on Euclidean geometry and topological relations, for example, place names and/or expressions that include direct or indirect references to place names. These topological place names and expressions must be translated into geographical coordinates that can be later interpreted and used by a computer. This formal handling of geographical information differs from the way people think and reason about it.

Some aspects of cognitive handling of geographic information by humans related in (Egenhofer and Mark 1995) have significant impact on how such information should be expressed in our corpora. People seem to develop spatial understandings by navigating it mentally and/or physically (e.g. "what is this", "where am I", "what is next to where I am at this moment", "where do I turn left to go to the shop", etc.). Thanks to this navigation and from partial point of view and observations, people construct their understanding of the scene.

In fact, much of geographical information contained in our textual corpora is neither denoted in terms of geographical coordinates (latitude, longitude) nor in terms of hours, minutes and seconds. Geographical information available in the corpora (this can also be observed in digital libraries and on the Internet) is expressed through place names and/or expressions that include relations (static or dynamic) and direct or indirect references to place names.

The aimed tool should permit to find all Information Units providing information about geographical facts in a given corpora (given by list ranked according to relevancy) that match a given description (i.e. a query or a graphical representation). Note that answers to IR queries should consist of Information Units rather than whole documents.
To cope with such needs, it is necessary to make a deep semantic matching – of geographical aspects – between query or graphical representations and passages. The method consists of 4 steps:

1) Firstly, detection and semantic analysis of geographic expressions are processed off-line on the whole corpora and the results are stored thanks to an XML semantic markup. We rely here on a semantic analyser that has been developed for several years and proves significant results (Malandain, Gaio et al. 2001), (Bilhaut, Charnois et al. 2003), (Mathet, Charnois et al. 2003). The core system of the analyser consists of three components: 1- tokenization, 2- morphological analysis and then 3- a definite clause grammar (DCG) performs altogether syntactic and semantic analyses. For spatial aspects, the grammar contains about 150 rules (depending on the variability and complexity of expressions), about 200 entries in an internal lexicon (depending on the variability of terms addressing domain, depending geographical localizations and relations) and a non-defined number of terms in an external lexicon (in our corpora towns' names, streets' names, motor cars' names…).
2) The purpose of the second step is to link topics of interest with spatial and/or temporal relation. To achieve this goal, a syntactic dependency approach is used. Most of spatial and temporal expressions act as locative or temporal complements, and expressions denoting topic of interest as subject or object complement.
3) In the third step, we process the schemas or queries in the same way, to obtain their semantic representation.
4) The last step consists in a semantic matching which is under conception, and the principles given here are partial and prospective. For spatial aspects, this step requires to link the tool to a GIS (Geographical Information System). Thanks to the semantic representations and their depiction in terms of geographic coordinates and topological relations through a GIS, the tool is able to find, for example, that a given place (e.g *6, Bramley Road*) is relevant for question 1: "*where did the accident occur*?), or coherent with a schema representing the itinerary of the different actors.

These four steps are domain independent in the sense that they can be applied to any type of electronic document that embeds spatial and temporal information. Yet, as explained above, performance of the analysis depends a/ on the quality of external sources you can provide the analysers with, b/ on the complexity of the corpora (level of language used, richness of the domain) that you want to treat. The next paragraph presents some results we can obtain for quite limited corpora dealing with road safety for which we had: a/ global positioning Information about actors, places and road signs, b/ thesaurus and semantics of road signs and on-road safe behaviours (see http://permisecole.com).

3. APPLICATION OF OUR APPROACH TO THE SMASH CASE STUDY

SMASH (ACTIS 2001), (Oudot 2003) is a cooperative Problem Based Learning (PBL) situation that we have designed to check and to implement our research actions. The Smash case is based on real-life incidents; pupils work as teams of investigators analyzing information to identify solutions to challenging and evolving situations. It addresses 10 to 12 year old pupils, and the underlying teaching objective is the road safety.
We chose this specific cooperative PBL because it relies on real documents including spatial and temporal information. We are first going to present an electronic white board functionalities we developed in order to support some cooperative activities. As the testimonies text complexity is rather limited, we are also going to show how we exploit this spatial and temporal information.

3.1. Smash: a cooperative PBL initiating 10-12 year old pupils to road safety

The main features of the situation can be presented as follows. A bicycle accident occurred in a village. Several cars are involved in this accident. Eye witnesses, pedestrians, motorists, and cyclists attended the scene. While playing the role of police inspectors, children, divided into 4 different groups, must piece together the evidence and decide what really happened. The main obstacle is nothing but the identification of the culprit. In this purpose, several resources are placed at their disposal: a set of testimonies (9 interviews of the pedestrians and other actors present on the spot), some Multiple Choice Questions (one by testimony), note sheets, a village map and a simplified highway code.

We used our CPM language (see references in paragraph 2.2) to model the Smash learning situation. The situation is structured in terms of acts, scenes, sequences of activities, and activities. For the Smash situation, an act corresponds to a teaching phase with a given duration. An act may be broken up into scenes; then, each scene may include sequences of activities which will be linked to roles. Thus, actors play a role in a sequence of activities. Resources are associated

to a role or, must be produced by a role within the framework of an activity. Various goals are aimed through a resource, an activity, a sequence, a scene, etc (Nodenot, Laforcade et al. 2003).
As Smash police investigators teams (roles) process different subsets of testimonies in act 2 (the investigation stage) it is obvious that a strong debate is going to arise during the 3rd act (the synthesis stage) to point out the guilty. We developed an educational e-whiteboard to support this specific cooperative activity. In fact, this interactive tool implements the police chief's and investigators' behaviour as well as the main topics (extracted from the testimonies, driving regulations, maps) modelled by the Smash case designers with the CPM language. So, it proposes several shared objects (road panels, witnesses and vehicles) related to important learning topics within the testimonies (see testimony n°1 in annex 1).

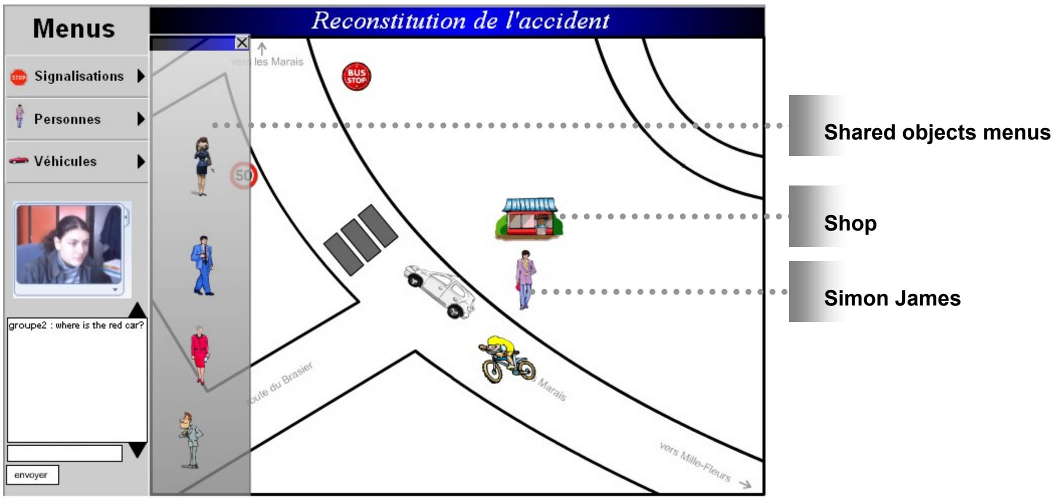

Figure 2: a Whiteboard-like cooperative tool for the Smash PBL situation.

Each group successively presents its works in order to pool all the results. The different groups become alternately Speakers (investigators presenting their works) and Listeners (investigators listening and\or asking questions). According to some testimonies interpretation, each investigators group position/rotate icons representing road panels, witnesses or vehicles on the map. The rights of each group are different. They cannot move all the icons. Each group, at his turn, argues his propositions. When there is a conflict about the position of an icon, a chat is started to support discussion and negotiation between groups. The police chief (tutor) can authorize an investigators group to display any testimony in order to help it overcoming some difficulties. In the same way, he can decide to visualize a testimony by himself and then help a group. At the end of each presentation, the police chief can, in his turn, ask questions to make sure the investigators group has understood correctly.

3.2. From the analysis of the Smash testimonies to the information models and tools of the Smash PBL situation

The Smash Information System (IS) model is deduced from the general class diagram presented in figure 1: concepts of the Smash IS are either specialisation of our general documentary concepts (e.g. *Document* class, *Information Unit* class, *Topic of Interest* class, etc) or instances of such concepts. For example, the *Testimony* class is a specialisation of the *Document* class and one particular instance is *testimony 1*.

Consider the first part of testimony 1 (see Annex 1 for the whole testimony): *I'd just come out of the shop and I was standing ready to cross the zebra crossing on my way to Bramley Road. I remember there was a woman waiting on the other side.*

- A *Fact* is a class of the Smash model (that specialises the *Information Unit* class) and a sentence or an auto-sufficient part of a sentence: "*I … come out … shop*" is an instance of *Fact*.
- In the same way, an *Actor* class in the Smash model is a specialisation of the *Active Topic* class; a particular vehicle or a human like "*Simon James*" are instances of *Actor*. Referenced actors instances such as *I* or *a woman* are objects which are used to refer to Actors.
- We can also mention the *Place* Smash class (that specialises the *Static Topic* class) and its "*shop*" instance.

All these instances (Simon James, the shop) are objects to be placed on the map displayed on the background of the electronic white-board (cf. figures 2 and 3).

To automatically extract such information from the testimony 1, the four steps process presented in paragraph 2.3 is executed. Here, we focus on the first steps of the document processing method and we exemplify these steps on the first sentence of testimony 1 (*"I'd just come out of the shop and I was ready to cross the zebra on my way to Bramley road"* translated into French):

1- To locate spatial and/or temporal expressions, a tokenisation combined with locals' syntactic and semantic analyses delivers the lemma, part of speech categorisation and semantics represented by typical structures (see figure 1). The following examples are in French since our analysers are designed for the French language (English translations of French terms are written between brackets):

"Je venais juste de sortir du magasin et je me tenais prêt à traverser au passage piéton qui se situe sur mon chemin pour aller route du Brasier."

<spatial_entity id= ''E8G8''> au <name_places id= ''E8F16'' type = ''element_de'' localisation= ''non'' position= ''internal'' > passage piéton </name_places> </spatial_entity>
….
<spatial_entity id= ''E8G14''> <name_places id= ''E8F26'' type = ''place'' localisation= ''non''> route </name_places> du <name_places type = ''nom_propre'' localisation= ''oui'' position= ''internal''> Brasier </name_places> </spatial_entity>

Figure 3: Detection and typical structures of spatial expressions.

Concerning place names, the heuristic is as follows: finding candidate terms such as words a/ preceded with terms like: "à (*at*), sur (*on*) , du (*of*), dans (*in*), etc." b/ belonging to a "substantive noun", a part of speech category c/ beginning with a capital letter or being a lexical entry of the domain-dependant lexical base.
Note that concerning the substantive noun "du magasin" (*the shop*), the process has not detected it with respect to the domain-dependant lexical base.

The previous step explained how spatial and/or temporal expressions can be extracted and semantically represented. The next step adds a supplementary natural language processing technique into the method.

2- The second step is composed of two phases. The **first phase** involves a syntactic dependency analyse of each sentence in order to identify potentially relevant/autonomous parts of the discourse i.e. the goal is to detect, mark and describe instances of *Fact.*

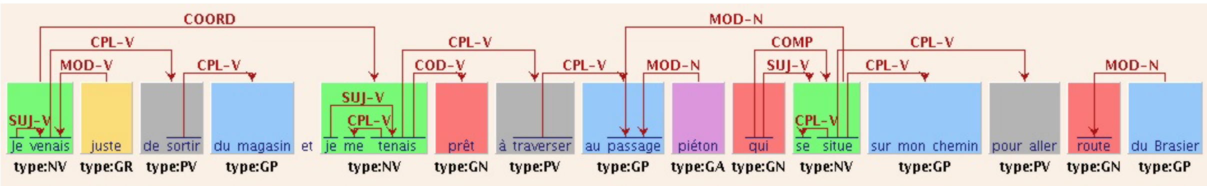

Figure 4: Graph of the syntactic dependency analyse.

Even in a quite small domain like Smash case, the complexity of the task requires the use of syntactic dependency analyses to reduce the large number of possible candidates. According to the automatic French syntactic dependency analyser (Vergnes 1999), the sentence could be segmented in 3 relevant/autonomous parts "je venais…du magasin", "je me tenais…aller", "route du brasier".
Moreover:

- o Subjects will be potentially considered as instances of *Actor.*
- o 3 of 4 substantive nouns previously marked as spatial expressions act as complements.
- o 3 of 4 verbs marked as spatial expressions act as complements.

The purpose of the **second phase** is to link each *Actor* with its geographic context. To achieve this goal, the approach combines semantic descriptions contained in lexical bases, part of speech categories and syntactic dependency. For example, applying this second phase on the first potential autonomous parts of the sentence, an instance of Fact could be: Je(*Actor*) venais juste (*Temporal context*) de sortir (*Dynamic relation*) du magasin (*?*)
Finally, according to part of speech category and the semantic description of the expression "aller" (referenced in the domain-dependant lexical base) and to the non-existence of any other relevant syntactic dependency, the third autonomous part which is "route du brasier" will be attached to the second one.

Such information extracted from the testimonies about the global positioning of actors, places, road signs, etc, at any time preceding the accident can be used to serve different pedagogical perspectives both at the designer's and the learner's level:

- o The Smash PBL situation becomes a dynamic learning situation since for example, the pedagogue/designer can upload a textual official police accident report, and then simplify it if necessary, going from the text to the corresponding computed graphical positions of actors and places.
- o The mapping between text (from the testimonies) and its corresponding graphical representation can be used to automatically generate an e-whiteboard interface whose menus are built with icons representing the only required actors, places and road-signs of given testimonies that the learner must analyse.

- These mappings can also be used to automatically check the validity of the learners proposals and if errors are detected to provide the learners with the very precise part of a testimony dealing with the objects (actors, road-signs, places) to be repositioned.
- The Smash PBL situation becomes also more dynamic for learners who can upload from the same set of tools different cases representing different accidents to elucidate.

We currently work on such functionality, both at design and implementation levels. Our current technical architecture for this e-whiteboard tool is distributed: we have an e-white board Communication Server (taking care and refreshing positions of shared objects moved by learners) which can exchange information with a PBL Application Server ands its Information System. The white board communication server shares objects like "*Simon James*" and the "*shop*" described within the IS. This is an interesting way to implement a generic PBL Application Server relying on an Information System that describes any proposed PBL. This allows us to manage dynamically information extracted from PBL resources and models at any time of the PBL design process.

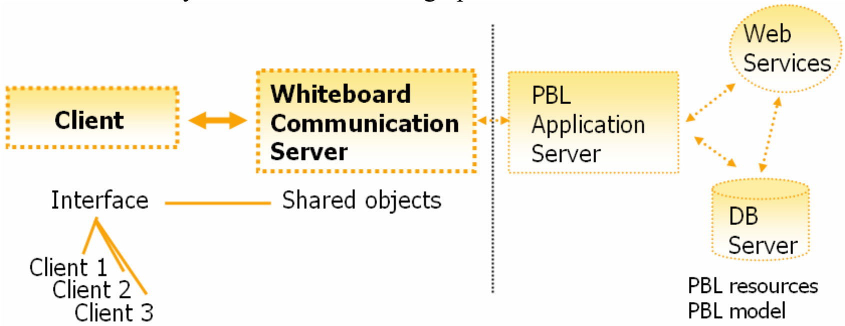

Figure 5: Smash e-whiteboard technical architecture.

4. CONCLUSION AND PERSPECTIVES

In this paper, we have presented our current works that consist in engineering Problem Based Learning (PBL) Environments that make use of electronic documents. The electronic documents that we focus on embed spatial and temporal information in relation with the learning domain. We showed the importance of such documents both at design time and at learner's regulation time. We broadly described our approach for marking and for contextualizing documents from spatial and temporal points of view, then we exemplified this approach for the development of tools dedicated to the Smash PBL situation.

Yet, the research which is conducted needs further investigation to better take into account temporal aspects and to enable us generalizing our current results for the Smash PBL situation to other learning situations. Our current agenda consists in transferring this work to PBL situations exploiting the geographical, historical and cultural patrimony of Bearn and Basque countries.

5. ACKNOWLEDGEMENT

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7. ANNEX 1: Testimony n°1, investigators group G1

Interview transcript:

Witness interviewed at the scene of the incident by PC Jeff Morgan and WPC Karen McGregor.

Name: Simon James
Address: 16, Bramley Road
Age: 22
Simon James: My name is Simon James of 16, Bramley Road. I'm 22 years old.
I'd just come out of the shop and I was standing ready to cross the zebra crossing on my way to Bramley Road. I remember there was a woman waiting on the other side.
There was a car coming quite fast out of Millford, towards Market Sturton. I think the driver didn't saw the zebra crossing. He couldn't has seen me until the very last minute because he had to stop very quickly - I heard the squeal of brakes. At the same time, a white estate car crossed the zebra crossing on the other side of the road without slowing down.
PC Morgan: Which direction was the estate going?
Simon James: Towards Millford.
PC Morgan: What happened next?
Simon James: Well, there was another squeal of brakes, I couldn't see exactly, but it looked as though the white car had hit a bike. I ran over to try to help. Someone else went for the phone. Poor kid, he was unconscious. Blood everywhere. His bike was a total wreck.