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Sébastien George, Hervé Labas

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E-LEARNING STANDARDS AS A BASIS FOR CONTEXTUAL FORUMS DESIGN

Sébastien George

Laboratory ICTT, INSA de Lyon

21, avenue Jean Capelle, 69621 Villeurbanne Cedex, France

Sebastien.George@insa-lyon.fr

Hervé Labas

MATICE, INSA de Lyon

1, rue des Humanités, 69621 Villeurbanne Cedex, France

herve.labas@free.fr

ABSTRACT

This article argues that linking communication to learning activities offers an interesting approach to develop the efficiency of learning management systems in facilitating and increasing discussions between students. We propose, present and elaborate a forum model that is based on two special features: a contextual view and forum structures. The contextual view of the forum, which is always visible, allows the user to focus on pertinent discussions. Two kinds of forum structures are offered: a content structure and a cognitive structure. In this paper, we discuss the use of some e-learning standards as a basis for the design of the contextual forum tool. The description of the conceptual framework for online communications and the computing implementation aims at giving researchers some possible uses and recommendations in dealing with context-sensitive communication tools.

KEYWORDS

Asynchronous Discussion, Collaborative learning, Computer Mediated Communication, Distance Education/Distance Learning, E-learning Standards, Learner Communities and Peer-Support

1. INTRODUCTION

In distance education, the emergence of learner communities has a favorable impact on learning conditions (Lave and Wenger, 1991). In a socio-constructivist approach, interactions between learners play a dynamic role in individual learning (Doise and Mugny, 1984). However, distance discussion tools are not always suitable for the emergence of learner communities. Some research studies have highlighted that the emergence of learner communities is rare in distance learning environments (Gommer and Visser, 2001; Hotte and Pierre, 2002).

Forum tools currently used in online educational platforms are mostly generic and not specific to particular educational situations (George and Hotte, 2003). More specifically, current distance learning systems do not recognized human communication process as a situated and contextualized process (Jakobson, 1960). Our main idea is to define a conceptual framework to support situated and contextualized communication interactions during learning activities. The aim of our work is to design forum models and tools which are specific to distance learning systems.

The forum models depicted herein are intended to foster text-based asynchronous discussions (i.e., a forum) during learning activities that are not inherently collaborative. During individual learning activities, providing only usual communication tools (email, forum, etc.) is not always sufficient to create interactions among learners. Usual communication tools could be appropriate if a collective learning activity is set-up. Nevertheless, in distance education, learning activities cannot always be collaborative. The

proposed approach aims at encouraging interactions during activities without collaboration overly scripted to learners.

In the rest of the paper we first describe the context and research issues about contextual forum before discussing the related research in the field of communication tools in educational context. We then present the design of two kinds of contextual forums, following by a study about their integration. We conclude with further work.

2. CONTEXT AND RESEARCH ISSUES

Low interaction levels between learners in forums might result from discussion tools and more particularly from their lack of connection with learning activities and learning contents: “the problem with content-related communication often is, that it doesn’t occur because it is a separate activity that is not include in the course” (Gommer and Visser, 2001, p.438). We postulate that the separation between learning activities and communication is not favorable for the emergence of discussions. We interpret learning activities broadly and include reading an electronic document, doing an exercise or using a simulation. Our research question lies in determining how to link discussion activities to learning activities by developing well suited computer tools.

Research dealing with situated actions introduce the interesting idea that action is not simply the execution of a plan but includes the user’s adaptation to the context (Lave, 1988 ; Suchman, 1987). The term ‘situated action’ underlies the idea that each action closely depends on the material and social circumstances in which it occurs. Communication is a situated activity (Lambert, 1992). Applying situated action theory to computer-mediated communication, Mantovani (1996) concludes that users are social

actors with their own aims and autonomy in situations, and it is technology which must adapt to them. In this sense, “the most effective way of clarifying the meaning of messages is to relate them to a shared context” (Riva, 2001, p.217). Situated action theory suggests that instructional communication should occur during an action or activity at the time when the user needs it. So if a user cannot communicate easily during an action or activity, the opportunity to communicate and share and exchange ideas will be lost. On the whole, our work concerns the design of human communication systems that attempt to respect human behavior and thought processes, that is to facilitate communication in action. These theoretical considerations guide the system design towards a more effective presentation of discussions. A more complete study of the underlying theories can be found in George (2006).

The forum model, named CONFOR (CONtextual FORum) is based on two special features: contextual view and structuring. The contextual view of the forum, always visible, allows learners to focus on pertinent discussions, i.e. on messages that correspond to their activities. Contextualization is common in annotation systems but not in forum tools. By adding this feature to forums, the intention is to closely link communications to learning activities. In order to provide this contextual view, discussions need to be structured. We suggest two means of structuring, according to (1) the content structure of an online course, and (2) the cognitive structure of an online course. The parts 4 and 5 respectively depict the design of these two ways of structuring contextual forum. We discuss before related works.

3. RELATED WORKS IN THE FIELD OF COMMUNICATION TOOLS USED IN EDUCATIONAL CONTEXT

Knowledge Forum (Scardamalia & Bereiter, 1999) is a communication tool dedicated to the educational context. This tool is a collaborative database developed for the process of 'knowledge building': defining problems and hypothesizing, researching and collecting information, analyzing and collaborating. The aim of this system is to help classrooms to become knowledge-building communities, in which all students are producers of knowledge. The interface of Knowledge Forum allows users to post notes and to link them together. The students structure the notes themselves. This tool was designed to support a specific learning activity: problem-based learning. Therefore, the students' activity is by definition collaborative; the tool is used to resolve a problem in group. Our interest is different. Our work concerns more generic forums which aim at promoting discussion during learning activities where collaboration is not scripted. Moreover, the view of the Knowledge Forum is not contextual and the tool is not linked to other learning activities.

Sampson (2005) suggests a tool named ASK e-EDCOM which allows web-based learning community members to discuss, comment and collaborate on a learning object. In this environment, every community member can offer a learning object and then this object can be discussed to be adapted to the community need. Our aim is quite different because we don't address autonomous learning communities' needs but virtual classrooms of learners that follow courses designed by teachers. So learners can comment learning objects or

discuss the course organization but they can't add directly learning objects, that is the job of the instructional designer for instance.

Nachmias, Mioduser, Lahav and Oren (2000) have worked on a particular educational configuration based on CMC technology. They develop a model of networked learning which is named Learnet. This model contains variables classified under three dimensions: community, technology and pedagogy. Comparing to ASK e-EDCOM, the approach of Learnet is quite similar with the work we present because there's a pedagogical framework around the learning community. The model is useful to analyse virtual learning environments but no tool is offered to support CMC. Furthermore, the model should be update. For instance, the content structure of an online course is considered as a simple web structure (named hyper curriculum) and do not take into account actual standards.

A large body of literature related to computer-mediated communication in educational context promotes the emergence of learning communities. The special feature of the proposed contextual forum is to closely link discussion activities to learning activities using existing structuring of online courses.

4. DESIGNING AN ACTIVITY-BASED CONTEXTUAL FORUM

The activity-based contextual forum aims at showing a partial view of the forum, that is to say the topics directly linked to the activity done by a learner at any time. This approach implies focusing on different points:

- the choice of the relevant standard for the course structure and how it will impact the forum's structure;

- the structure importation method, based on the chosen standard; and,
- the way the forum view should be refreshed, in order to keep the link between the learner's activity and the related topics.

4.1. Standards for online course structures

To set-up an online course, it is necessary to describe how learning objects and resources are organized: which is the learning resources order or path, what are the combining of learning objects, and so on. This is the step of specification of a course structure. There are currently several ways to describe a course content structure. Standards such as AICC (*Aviation Industry CBT Committee*) and SCORM (*Sharable Content Object Reference Model*) are currently used by a lot of industrial and educational organizations. These kinds of standards allow a designer to describe courses with a classical structure that includes modules, chapters, parts, lessons, and so on. SCORM was developed after AICC, and found lots of its bases in the AICC standard.

Other standards exist to model learning activities. For example, work on Educational Modeling Language (Koper 2000) is at the origin of the IMS Learning Design (IMS LD) standards (IMS, 2003). CONFOR was designed in the beginning of IMS LD, which is why it found its bases in SCORM as SCORM was more developed at the same time. We will focus on the SCORM structure before analyzing the interest of using IMS LD in the future.

With SCORM, educational content may be sequenced for the learner: "One activity in the process of creating and delivering learning experiences involves the creation, discovery and gathering together, or aggregation, of simple assets into more complex learning resources and then organizing the resources into a predefined sequence of delivery"

(Dodds and Thropp, 2004a, p.18). The SCORM content aggregation model is a profile of the IMS Content Packaging specification, an IMS standard designed to describe a course in a package containing the course's files and an XML document describing the structure: organizations, items, resources and files (Dodds and Thropp, 2004a). The course structure (organization) contains pedagogical information that indicates how a learner will go through course activities. Thus, this organization described in the XML manifest file provides a way to retrieve easily a course structure and to use it for other means, such as a forum tool.

Concerning IMS LD, this standard is based on the learner's activity and describes pedagogical scenarios that he or she will follow during a session. Those scenarios introduce sequencing notions, pre-requisites, actor roles, and allow an elaborated pedagogical design. A deeper analysis could lead to a model allowing an IMS LD importation to get a forum structured as the pedagogical scenario. It is specified by the IMS Global Learning Consortium as follows: "Each activity refers to a collection of specific objects and services (called the 'Environment') needed to perform the activity. In order to support the description of individualized learning designs, learner Properties, Conditions, and Notifications are needed." (IMS, 2003, p.4). This approach allows for the possibility of integrating CONFOR as a service within this Environment, as it is designed according to e-learning standards.

Standards evolve. For instance, they are presently discussed (IMS, 2005) to be updated and standardized by IMS, ADL (SCORM authors) and IEEE LTSC (Learning Technology Standards Committee). Standards might evolve so as to lead to an almost universal way to describe a content structure. Standards offer a solid and sustainable basis for designing

contextual forums. To conclude this part, CONFOR is not bound hand and foot with a particular standard and it will evolve in the same time than standards.

4.2. Contextual forum based on course structures

We designed a contextual forum tool based on a strong parallel between learning activities (course structures) and discussion activities. In this approach to forum structuring, each forum thread is linked to a course content item. Each root message of the forum is a reference to a learning activity. Thus, a reference could be for example the title of a course chapter or the number of an exercise. The forum is then hierarchically structured according to learning activities, by reference to the course structure. According to the kind of contextualization discussed, opening of an educational object leads to the opening of a forum view corresponding to the activity in progress. The goal is to focus learner exchanges on learning objects and specific learning activities.

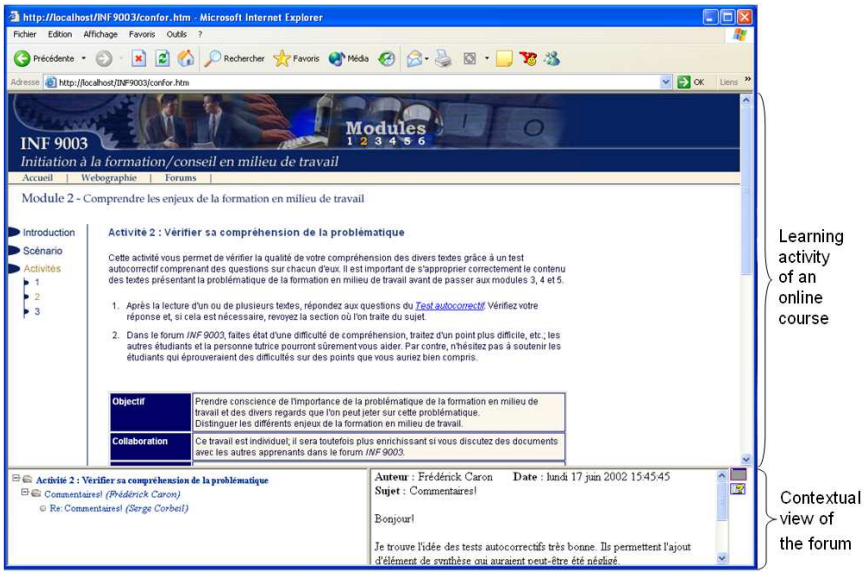

Figure 1. Screen shot of CONFOR

The interface of the CONFOR tool is shown in Figure 1. The upper part of the window contains a learning activity of an online course. Under this course is the contextual view of the forum, which is automatically updated depending on the upper part. For instance, in Figure 1, a learner carries out the activity 2.2 of the module 2 of his/her course and s/he sees, at the same time, the messages of the forum that correspond to this activity (messages under the reference 'activity 2.2'). This contextual view of the forum is a part of a unique global forum. It should be noted that this global forum can be displayed in a global view (to see the entire tree of messages). In both views – contextual or global – the left part of the forum displays the list of the message titles and the references names. When user clicks on a message title, the content of the message is displayed on the right part of CONFOR. The forum can be resized or put in an always-on-top window.

In order to provide the contextual display of the forum, we have to define references in connection with the online course structure. In this model, references contained in the forum are linked to the learning activities structure. References are dependent on the course structure designed by the author. We suggest an automatic procedure to add references in the forum. We describe this procedure in the next part.

4.3. Mechanism for importing course structure

As we initially chose SCORM for data importation, the design of the module to import course structures is essentially based on the analysis of XML manifest files. A class modeling can be obtained to virtually represent the course structure and then manipulate those objects in order to create a valid forum structure.

An objective of SCORM, as a profile of IMS Content Packaging, is to provide a broad sphere of activity to a course designer, by allowing recursive inclusions of manifest elements. Each manifest element describing a structure, a designer may aggregate many structures in only one package, and have lots of possibilities. As we seen on part 3.1, in a manifest element, structures are described with the organization elements, containing item elements. Each item can be linked to either a resource or a (sub)manifest package (Dodds and Thropp, 2004a). The possibility of recursive inclusions of manifests emphasizes the fact that a package can lead to many potential structures.

Therefore, we end on the following steps for a content packaging import:

1. Package selection and definition of import options.
2. First analysis to present the contained courses organizations.
3. Presentation of the structure to import, regarding on the user's selection.
4. Creation of the forum structure(s).

4.4. Using learner navigation to display contextual discussions

SCORM describes the way content objects should be launched by a LMS (Learning Management System). This part of the SCORM specification is known as the SCORM Runtime Environment (Dodds and Thropp, 2004b). It essentially describes an interface between a SCORM compatible LMS and a content object. This interface consists of functions a content object can rely on to dialogue with the LMS. This Application Programming Interface (API) defines especially two functions, *LMSInitialize()* and *LMSTerminate()*, that a content object should call respectively at its beginning and at its end. This special feature can be used to reach the goal of updating the forum contextual

view. Interfacing the forum tool with a SCORM compatible LMS presents no major problem.

Another approach is currently study to provide CONFOR as a Web Service, usable by any kind of LMS. This service would be totally independent of platforms. Some services (like create a contextual forum, add a message, etc.) could be call by any LMS that would only have to take care of the display part (user interface).

4.5. Results from an experiment

An assessment has been carried out at the Tele-university of Quebec to evaluate the contextual forum. CONFOR was assessed within an introductory course on “training in the workplace” offered to students registered in an undergraduate certificate program in business-oriented computer sciences. This course is an e-learning environment that integrates several learning objects linked together by an educational scenario (Paquette and Rosca 2002)

The experiment lasted 8 months and about 70 students have taken the course. During the evaluation, two tutors supervised the students. The goal of the assessment was to study the use of CONFOR. More specifically, we wanted to test the utility and usability of the forum contextual display. For the purposes of the assessment, we used questionnaires, interviews, and regular observations coupled with computer traces analysis. It should be pointed out that the course used to assess CONFOR was newly offered by the Tele-university. For this reason, we could not directly compare the use of CONFOR with that of other forums used at the Tele-university, too many parameters being different.

The forum was divided into two categories for the purposes of this assessment: ‘general’ and ‘course’ The ‘general’ category is for discussions not dealing directly with course content. For example, students can use it to present each other or discuss administrative problems. The ‘course’ category has a reference-based structure. It is accessible in a global mode (in which students can view all messages, classified according to the course outline) and a contextual mode. We made the ‘course’ reference-based structure very detailed—down to the document level. In this way, all html pages and documents in .doc and .pdf formats are referenced in the forum.

The students and their tutors connected with the training environment 2,923 times and sent 437 messages to the forum. Message distribution by category is as follows: 167 messages for the ‘general’ category, and 260 for the ‘course’ category. Figure 2 provides details of the messages sent.

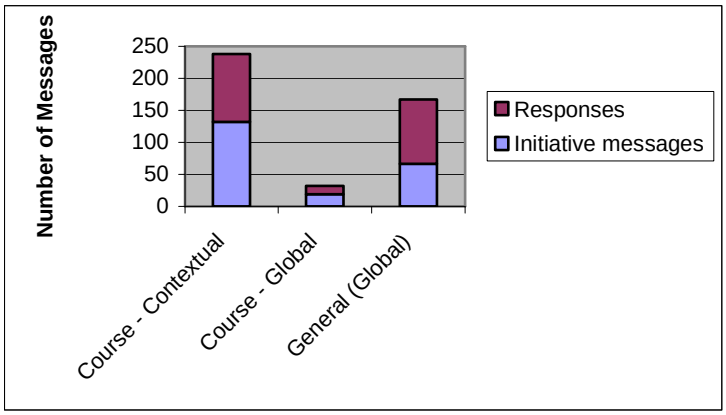

Figure 2. Messages sent in contextual and global modes

For the ‘course’ category, nearly 7.5 times more messages were sent in contextual mode than in global mode. Most users were thus using the forum’s contextual display to send messages about the course. Also of note is the fact that a higher percentage of messages in

the ‘general’ category (60.5 percent) were responses to other messages than in the ‘course’ category (44 percent). In our opinion, users tend to make use of the ‘course’ category’s structure to make notes and annotations that do not always require responses. How the messages are read also differs depending on forum category and mode (Figure 3).

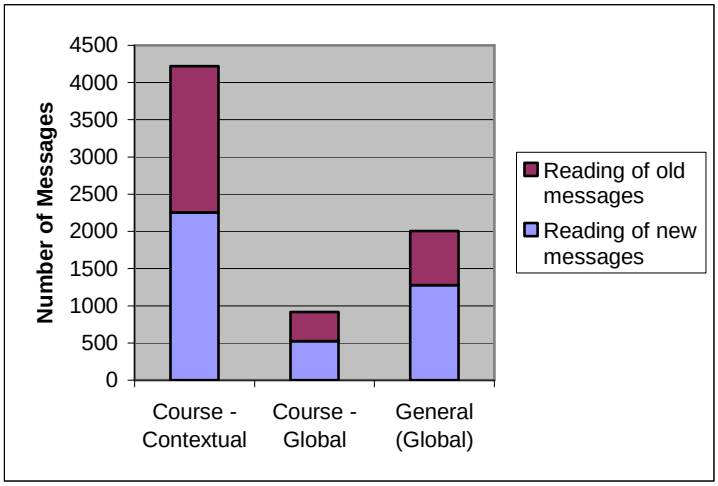

Figure 3. Messages read in contextual and global modes

In the ‘course’ category, there were over 4.5 times more messages read in contextual mode than in global mode. Comparing global mode with contextual mode, we note that contextual display favors the rereading of messages (46.6 percent of messages read were re-reads, compared with 36 percent in global mode).

To get feedback from students on their use of CONFOR, we sent them a survey questionnaire made up of closed, multiple-choice questions, with space to include comments. We received 27 responses to the questionnaire (39 percent of users). What follows is a brief summary of the qualitative results. The questionnaire responses indicate that the students are quite appreciative of the reference-based structure of the forum. Similarly, they favor the forum’s contextual display, i.e., the display of portions of the forum, depending on where one navigates in the course. The results also indicate that

CONFOR is better at helping students find messages relevant to their activities, i.e., messages useful for the learning activity they are currently engaged in. Finally, students found that the forum fostered the organization of discussions. From the standpoint of usability, they had no trouble handling CONFOR; however, some lamented the lack of a search tool.

Since forums are also an important tool for e-learning tutors, we conducted semi-structured interviews with them to obtain information on their use of CONFOR. Tutors found the interface simple and intuitive to use. Concerning utility, tutors appreciated having the forum and the course on the same page. They appreciated the ease of locating new messages, which facilitated their monitoring activities.

At this point, we can conclude that contextualization of discussions for learning activities is appreciated and has some potential. Users seem to appreciate the fact that communication and learning are integrated into a single space. Having access to the opinions of others, as they carry out their learning activities, motivates students to locate discussions that help them to understand and to build their knowledge. From this point of view, we can contend that this kind of forum has a positive effect on learning. More detailed results of the experiment could be found in (George, 2004).

5. DESIGNING A KNOWLEDGE-BASED CONTEXTUAL FORUM

From the precedent work on activity-based contextual forum, an issue emerges: it would be a good idea to propose a different structuring of forum, by defining references in connection with knowledge dealt in online courses. From the first assessment of CONFOR, we observed that two messages could be situated in two different threads even though

these messages dealt with the same content or with the same knowledge. So the goal became to design a structuring model based on knowledge representation while keeping the contextual view of forum. With this approach, the forum tool could provide some facilities for discussions convergent processes that are not supported in conventional threaded discourse environments (Hewitt, 2001). We then use e-learning standards and taxonomies in order to retrieve knowledge elements tackled in online courses.

5.1. LOM and Dewey Decimal Classification

In online education, the metadata are used to describe the courses and the learning objects. They include a number of descriptors which are defined according to a standard, and which enable to make these courses and learning objects more easily accessible and usable (interoperable, reusable, long-lasting, adaptable) (Downes, 2001).

The standard LOM (Learning Object Metadata) is limited to a minimal set of essential characteristics to manage the learning objects, to seek them and evaluate them. A learning object is regarded here as "any entity, digital or non-digital, that may be used for learning, education or training" (Hodgins and Duval, 2002). Others approaches exist to describe links between knowledge and learning contents. Among them, uses of ontologies are studied for the management of learning objects (Aroyo, Mizoguchi & Tzolov, 2003; Hayashi, Ikeda & Mizoguchi, 2004). We choose to use LOM because it is a standard. Nevertheless, the proposed model could be extended in the future to be compatible with other knowledge structuring.

In LOM, nine categories are taken into account in order to describe the educational resources, but according to our objectives, they are not all of the same importance. The

ninth category, named “classification”, is the category that particularly interests us in our context. This field ensures to classify and index educational objects according to a knowledge taxonomy. We studied various taxonomies which enable to describe the knowledge-elements approached in learning documents. We studied in particular the taxonomies used by the libraries: DDC (*Dewey Decimal Classification*), UDC (*Universal Decimal Classification*) *and* LCC (*Library of Congress Classification*). Among those we retain the DDC because it is flexible, simple to use and allows a classification of knowledge sufficiently fine for our work.

However, providing metadata is not always an easy work for authors of learning objects. From their point of view, this work requiring a literature study, which is not always in their field of competences, is tiresome and non-productive. We believe that it will be one of the major problems for the development of educational objects. However, we take as a working hypothesis that, to use CONFOR, each learning object will be well documented and described with LOM. If this work is not done by authors, information specialists could do it.

5.2. Contextual forum based on knowledge

We suggest a model of knowledge-based forum, in which the topics are organized according to a structure defined by the knowledge tackled in a course (see an example on Figure 4). With the attribute ‘classification’ of the LOM description of each educational object, the knowledge elements being consulted at a time can be identified. Therefore, a forum function can show in a contextual way all the topics corresponding to these

knowledge elements. The learner may then consult, share and interact with other learners about the course content.

Figure 4. An example of forum that is structured according to knowledge elements

5.3. Module to import knowledge structure

The use of LOM within SCORM lets a course designer the possibility to describe each resource referenced in the course, by using the metadata element. This element allows any kind of metadata description, so LOM can be used in particular to classify each resource, by using its ninth element named classification. The classification element contains a knowledge identifier (named 'taxon') relative to a given taxonomy, as the Dewey Decimal Classification. Resources metadata definition gives all needed information to handle a knowledge structure: each taxon identifier can be analyzed to rebuild the entire knowledge structure for a given course. This structure is kept within a particular forum, and will therefore reference any discussion about a given 'knowledge element'.

As a remark, this mode encourages fulfilling every resource metadata by taking advantage of the classification definition, and getting the cross navigation, as interactions, richer.

5.4. Mechanism to detect knowledge elements consulted

As depicted in previous part, with the attribute ‘classification’ of LOM, we can identify the knowledge elements (KE) being consulted. Therefore, a function of the forum can show in a contextual way the topics corresponding to these KEs. In this way, a learner who wants to discuss about the knowledge-element number 1.1 (KE1.1) approached in a learning object 1 (LO1) will be able to see all the messages under the topic KE1.1 and will be able to post his/her message under this topic. Moreover, several KE could be shown at a time if the LOM description contains more than one Dewey Decimal Classification identifier. The learner may then consult, share and interact with other learners about the knowledge treated in the course.

The Figure 5 shows how a learner uses an online learning environment to consult his/her courses and to communicate with the forum. At a given time, s/he can open a particular learning object (1). A function of the system recovers automatically the DDC indexes of the KEs treated in this LO (2) using the LOM description. Then, the forum seeks the DDC indexes of each KE in the structure of the forum (3). The forum then opens in a contextual way (4) by showing the messages in relationship with the KEs treated in the LO.

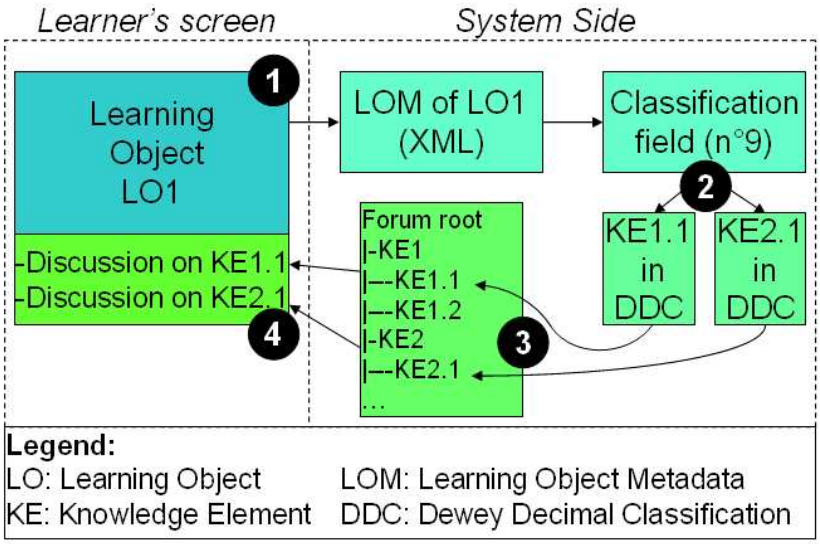

Figure 5. Mechanism of the knowledge-based contextual forum

An advantage of this mechanism is that two students who work on two different LOs will be able to meet on the same forum to discuss a common KE.

6. TOWARDS AN INTEGRATED APPROACH FOR A CONTEXTUAL FORUM

Our current research concerns the integration of the two models presented above. Actually, using a singular approach has some limitations. In the first approach, contextual forum based on educational scenarios, some messages could be situated in different threads even though these messages dealt with the same content. In the second approach, knowledge-based contextual forum, general discussions about learning activities have no place in the knowledge structure.

The idea of integration consists in showing the learners a discussion thread corresponding to the current activity (to discuss about the organization inside the course

for example) and also several discussion threads corresponding to knowledge at stake at a time (in order to discuss about the content). The Figure 6 depicts a model which takes into account these two levels of contextual discussions.

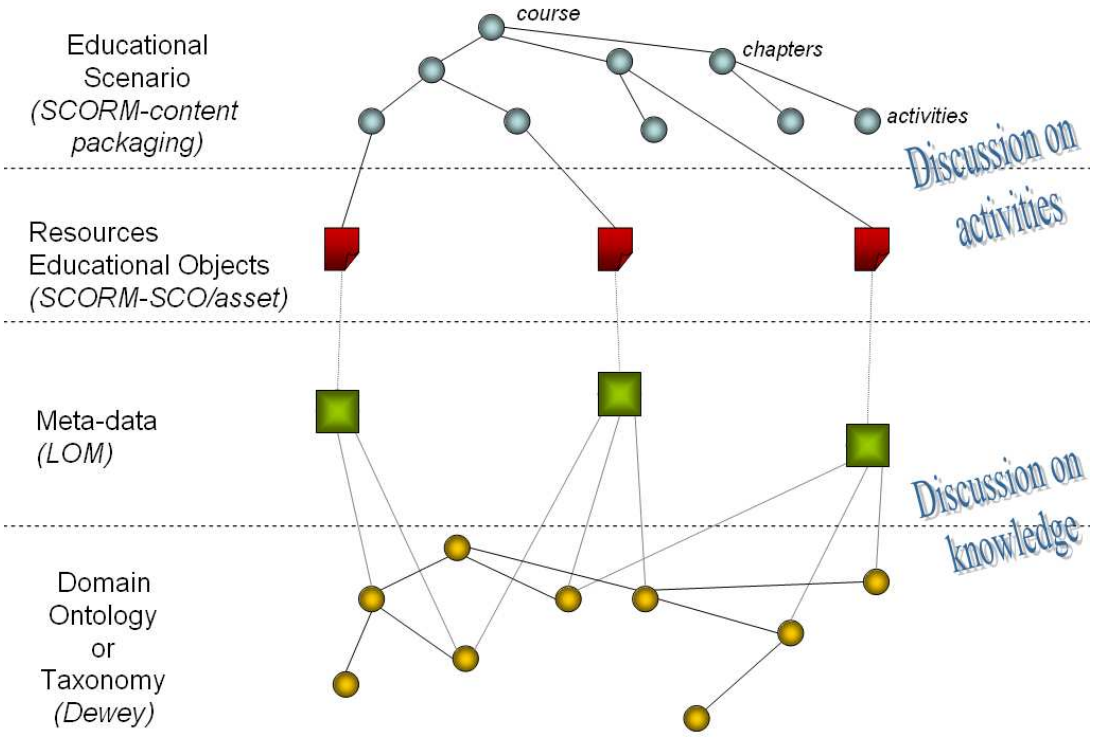

Figure 6. The integrated model of contextual forum

In this model, an educational object – or a resource – is referenced as an object of an educational scenario (in the upper part of Figure 6) and this object also deals with several knowledge elements described in its metadata (in the lower part of Figure 6). Knowledge elements could be defined by an ontology of a particular field or by a taxonomy like Dewey (DDC). Always in this model, each circle is then a discussion topic inside the forum. So, when a learner opens an educational object, the contextual forum displays automatically the activity topic and all the knowledge topics linked to the resource.

Finally, the Figure 7 shows the interface of the integrated contextual forum. Two thumbs enable to see either the activity-based contextual forum or the knowledge-based contextual forum.

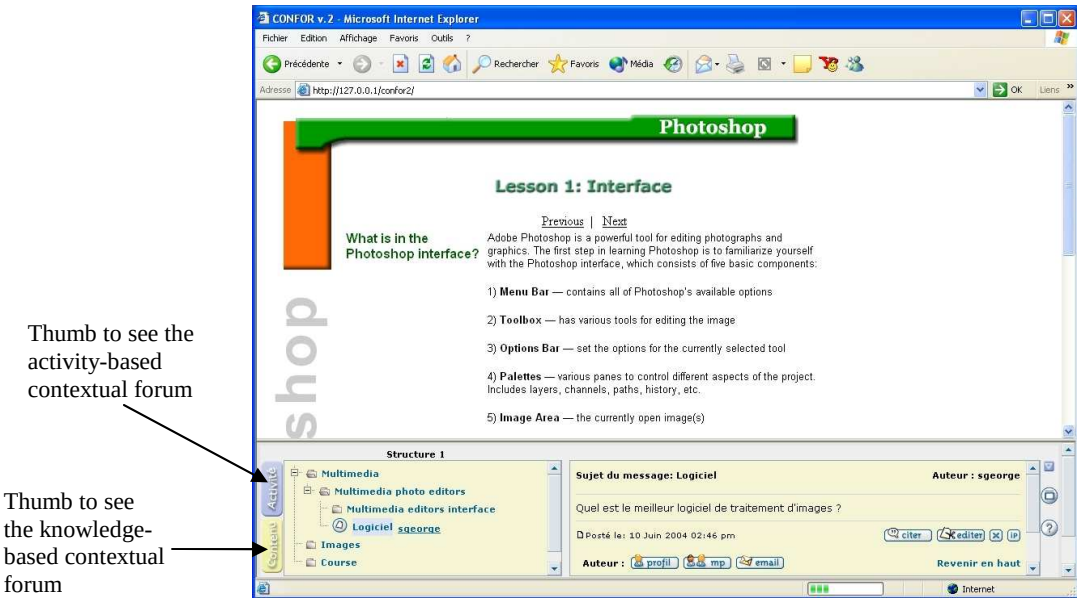

Figure 7. The integrated interface of contextual forum

Before the learning session, the automatic import of course structure and knowledge structure could be made in the same time. The Figure 8 shows the interface which allow to retrieve both structures during the analysis of the IMS *manifest* file.

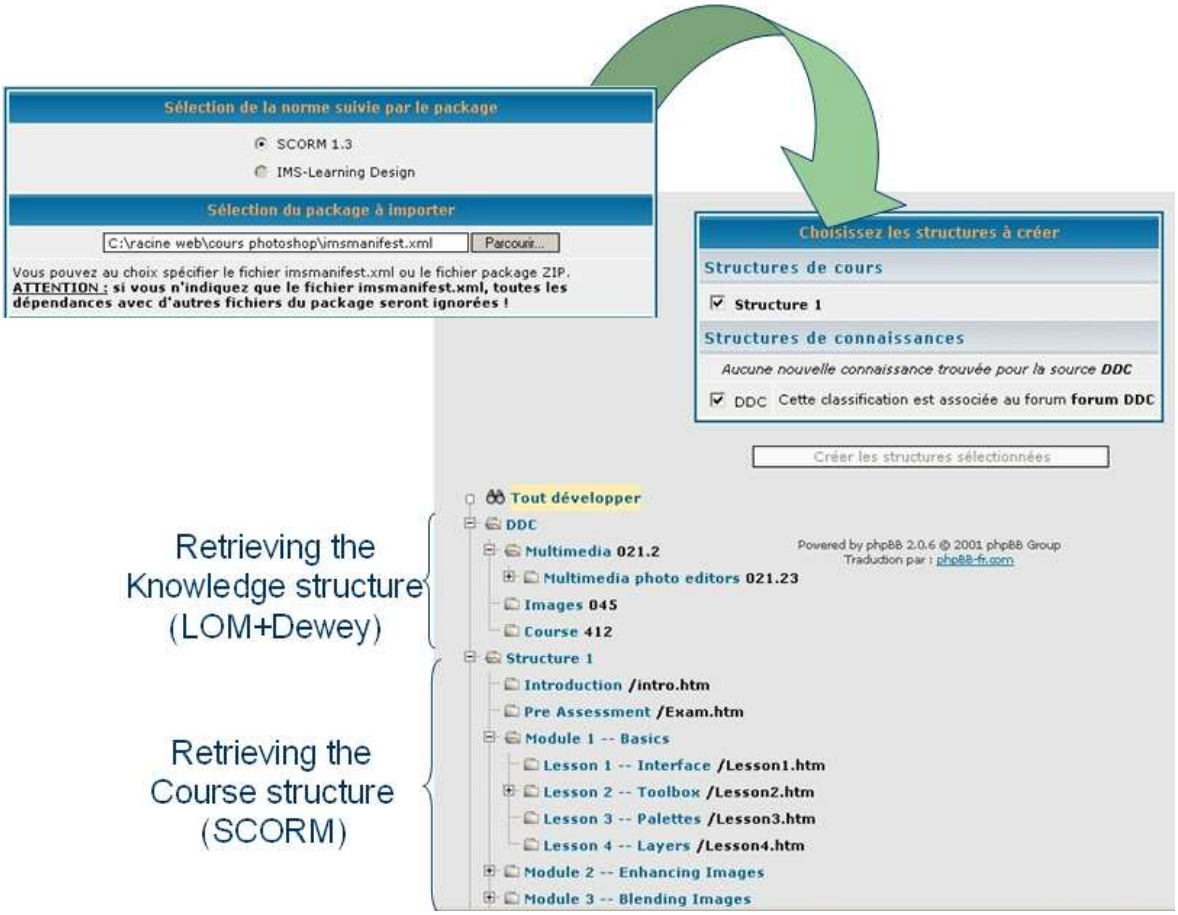

Figure 8. Automatic import of course structure and knowledge structure

However, with this integrated approach, the context is limited to the activity in progress and to concepts studied at a time. Regarding situated actions theory, we should extend the notion of context, taking into account more parameters such as learner's history or learner's goals. Then, we could use this information to better adapt displayed topics to each user. For example, carrying out the same activity, two learners would see different and specific discussions topics according to their past actions and to their personal characteristics.

7. CONCLUSION AND FUTURE TRENDS

Our research aims at proposing specific forum models and tools for online education in order to foster discussions between learners. The work led to the idea of contextual display of forum messages. We suggest two versions of contextualization. The first one is based on a forum structuring according to online course structures. Some results of an experiment led us to study another forum structuring, by taking into account the cognitive structure of a course. The result is a discussion tool, named CONFOR, which displays to the learner an activity topic and several knowledge topics linked to the learning resource that is open. The last version of CONFOR will soon be tested in order to validate the integrating model. Moreover, a long-term experiment with several groups of students will be conducted to measure the impact of CONFOR on the quality of learning. Another relevant element for measuring this impact concerns the integration of CONFOR in common learning platforms as an independent web service, to allow a wider use and experiment its functions at a large scale. The work of designing a CONFOR web service, easily pluggable in any learning management system, is currently done in cooperation with the Tele-University of Quebec.

The CONFOR model and tools are based on current emerging e-learning standards. In particular, CONFOR uses, in one hand, SCORM for the learning activity structure and, on the other hand, LOM combined with Dewey Decimal Classification for the knowledge structure. Nevertheless, CONFOR could easily evolve to take into consideration other standards, like IMS-LD or future standards (IMS, 2005).

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