LINC: A WEB-BASED LEARNING TOOL FOR MIXED-MODE LEARNING

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Abstract: In this paper we discuss some basic theories of learning and e-Learning. With the light of the appropriate theories, we then describe the components and particular features of our e-Learning system, the Learn IN Context System (LINC). This tool aims to be used in institution's courses in mixed-mode learning. Finally, we report our initial experimentation with this tool and some preliminary results and evaluation.

1 INTRODUCTION

The tool presented in this paper is developed to apply both educational and e-learning theories which are appropriate according to our point of view. This tool is a Web-based learning tool used in mixed-mode learning. This mode combines face to face and distance approaches to education in that an instructor meets with students in class, and a resource-base of content materials (such as multimedia files, video clips) and learning activities (such as forum) are made available to students through the web. To accommodate the researchers in this domain, we will firstly discuss some related theories, and then describe the tool with some particular features, such as the content of the forum (which is displayed in the foreground) is anchored to each course's topic in the background, and each learner is assigned to a small group allowing both the competitive and collaborative learning; finally we will report our initial experimentation and preliminary results and evaluation.

In the actual knowledge society with the extensive use of the Web, one can find out thousands published documents concerning a general subject. To avoid repeating the same ideas, we don't hesitate to introduce in this paper several quoted texts with references to the original documents published on the Web by researchers in the community.

2 THE BASIC THEORIES OF LEARNING

All professors practice some educational theories in their daily teaching, with or without consciousness. To summary the bulky discussion about these theories, we cite below some core ideas expressed by the four tenor authors in the literature (text and references extracted from the Rik Min's Web site, see the reference at the end of this paper):

- "Seeing the student as active agent in learning […], constructivists are now emphasizing the individuality of information processing where each individual determines his or her own conception of the world." (Mason, 1988, p. 207).
- "Objectivists believe that the mind mirrors reality while constructivists maintain that the

way in which the world is perceived is a product of the mind (Jonassen, 1991). The assimilation of new knowledge into an existing cognitive structure is an idiosyncratic enterprise of perceiving, interpreting and building of meaning in the context of what an individual already knows. […] The meaning that is generated by each learner for material they see is individual and cannot be controlled by the author (of that material)." (Jonassen, 1988, p. 153).

- "In practice, an intermediate position may very well be adopted and appears to be more the rule than the exception. […] Instruction has thus to be adapted to the learner, but also the learner has to adapt to the instruction: instructional designers and communication specialists have to reckon with the idiosyncrasies of their audience, but at the same time may require an audience to be accessible to their messages. The basis for this may be formed by sharing enough fields of experience to understand each other (see also Schramm, 1954)."

- "Where a risk exists that learners may derive meaning other than intended from information, new information should be embedded in a context that shapes the possibilities for interpretation into the desired direction (Vygotsky, 1978, p. 86)."

Through these representative ideas, there is an evident mutual complement for the two opposing learning theories, the objectivists and the constructivists – including cognitive and social constructivists.

From our own point of view, on the one hand, we agree that the learners often construct the new knowledge according to the current state of their mind; but in many courses, such as programming courses, there are several (programming) rules the students have to learn. In these cases, it is unacceptable to let the learners change the rules according to their own ways of "knowledge construction", because there is only one right rule's interpretation. Put in different words, we must guide the learner's knowledge construction. Moreover, much of works has done from decades in the Intelligent Tutoring Systems related to the causes of the learner's misconceptions or misunderstandings; detect them and remedy them as soon as possible are the responsibilities of the teachers.

But, on the other hand, we have enough teaching experiences to know that learning only occurs if the learner does some efforts. These efforts allow establishing or modifying the required links between the short-term memory (related to the new knowledge) and the long-term memory (related to the existing knowledge). To facilitate these efforts, several ways can be taken; for example, "through

conversations about a subject matter which serve to make knowledge explicit," (Kearsley, 2002), or "One type of collaboration that is commonly encouraged in academic online learning courses is discussion board interaction. […] The power of this practice is evident to anyone who has ever participated in such a forum. Collaboration also supports active participation through group projects and reinforces important practical skills like group communication, project management, conflict resolution, and group brainstorming." (Galarneau, 2004).

Experiences tell us that we should offer as much as possible opportunities to the learners to actively engage them in the learning process; for example, by talking from their mouths the learned concepts, by practicing the rules (or procedures), and by discussing with us and between them about the underlying topics. "From a constructivist point of view, the pedagogical emphasis is on collaboration and discussion. Consequently, lecturers must engage students in a dialogue about the curriculum and the subject matter to be covered. Students are invited to contribute to the dialogue and are given opportunities to express their interests and learning goals." (Otting and Zwaal, 2003).

In addition, we have also apply the well-known and proven theory of Gagné *et al.* (1992) about the teaching of procedural knowledge, which will be better done if it is accompanied by demonstrations. Thus, for an e-Learning mode, some multimedia materials must be created, for example, the animation Flash files or some video clips that are easy to get for any domain. As noted by Clark and Mayer (2002), "Multimedia presentations encourage learners to engage in active learning by mentally representing the material in words and pictures and by mentally making connections between the pictorial and verbal representations". Learning theories abound that also support these ideas. "Imagery has been shown to facilitate recall in many studies," and Dual Coding Theory suggests "recall/recognition is enhanced by presenting information in both visual and verbal form." (Kearsley, 2002).

3 THE BASIC THEORIES OF E-LEARNING

In his paper, Nichols (2003) notes "It is unlikely that e-Learning practice will continue to evolve unless the theoretical underpinnings of e-Learning are explored and debated, providing a wider platform and a common philosophy for e-Learning development. […] Skinner's behaviourism, Piaget's

cognitive constructivism and Vygotsky's social constructivism can all be facilitated through e-Learning". He also talks about the use of interactive media resource in e-Learning: "Indicative interactivity is typified by the use of button rollovers and site navigation. Clicking a button to start an animation or turn the page is indicative interactivity (the ability to fly a virtual plane in a realistic virtual environment is simulative interactivity)". From these perspectives, he proposes ten general hypotheses as the foundation of e-Learning theories. Among them, we are interesting in the hypotheses #5 and #6 as followed:

- "e-Learning can be used in two major ways; the presentation of education content, and the facilitation of education processes". The fundamental applications of e-Learning include digital materials storage and distribution (presentation) and synchronous and asynchronous communication, simulative interactivity, multimedia, and access tracking (processes) – each of which is subject to multiple applications of use and innovation.

- "e-Learning tools are best made to operate within a carefully selected and optimally integrated course design model." There is general agreement across existing education literature that collaborative dialogue and communication with instructors are major contributors toward successful learning.

Several recent projects confirm these hypotheses. For example, Britain (2004) states that: "Whilst learning is an effortful and active process of knowledge construction that humans perform quite naturally, not all learners are equally capable of effective and efficient learning on their own. Indeed, most if not all, benefit from some level of guidance and support". In the same line of thought, Lopez-Islas (2004), in his report on a wingspread project with 22 online courses, defines "Collaborative learning (CL), as a participatory learning mode, is a process of social construction of knowledge that takes place in the context of communities of inquiry. Besides a cognitive component – the social construction of knowledge process – there are two additional elements that play a significant role in the functioning of a community of inquiry: the social presence and the teaching presence." Finally, as reported in the experience of the Cardean University (Gunawardena, 2004), "interaction was an add-on feature, and students did not see its relevance to meeting the course objectives". Thus, for an effective student collaboration, the course designer must focus on community building (rather than on individual) as the central concept. The role of instructor in CL is important, because the personal qualities required for an effective CL team as described in (Soller et al., 1998), such as participation, social grounding, conversation skills, group processing, and promotional interaction, are so ideal that not every student can have them. The experimentation with our e-Learning tool described below aims to confirm these two mentioned hypotheses.

4 LINC: AN ONLINE AND IN CONTEXT LEARNING TOOL

4.1 Some particular features

Galarneau (2004) notes that: "The hallmark of the constructivist approach is the creation of a learning environment that allows learners to construct their own knowledge via active participation and reflection, rather than simply being offered information". From a technical point of view, according to Kirkley (2004), "it is critical that researchers have the necessary tools to examine student interactions and address issues related to real world applications as well as theory development". These ideas about online CL systems are realized by several web-based techniques. For example, one may integrate a chat window or a forum through a public or private communication channel. But theses features, separated from the underlying learning context, are resemble to an interactive and communication system; that justifies the developing of our "in context" system as described below.

Moreover, to design a good e-Learning tool for CL we must avoid some common issues rising from applying or developing them. For example, (1) the teachers fear to apply them in the classroom (because the loss of control in the classroom); (2) the students resist to collaborate together (because the lack of familiarity with CL techniques and class management), and (3) one of the obstacles for the implementation of collaborative activities is that students are accustomed to working competitively, not cooperatively (Bosworth, 1994).

With lessons learned from our past projects and the above experimentations from others, we have developed an online CL system called LINC (Learn IN Context) to be used in a mixed-mode learning (i.e. in parallel with our face to face course). Some features of this system are:

- **Instructor and learner's roles** are dependant on the learning content. If it is the concept learning or task learning, then the instructor's roles is more evident as animator, facilitator, and questioner. If it is a project realisation, then the learner's role will be more important and the

instructor can play the role of clarifier, mediator, explainer, etc.

- **Group size** is manageable for communicating. Ideally, the size should be small enough to facilitate the solution tracing, and to allow an effective group animation. We hide each individual learner under a group label and limit the number of groups at most six; that helps to eliminate the learner's embarrassment and encourages both the collaboration in each group as well as the competition between groups.
- **The forum for participants** is directly implemented by a foreground window so that the learning context permanently exists on the interface. The messages exchanged between participants are anchored to each topic; whenever the topic changes, the email box's content changes too. At the end of a course, the instructor can trace all messages to understand what the learners' difficulties are and how the learners reach the final response or solution. Thus, the next course's content may be improved.
- **Time control** is flexible. Instead of a fix appointment with the presence of all learners, we use a deadline control approach or asynchronous learning system. Learners could work at their own pace, at times convenient to them. At anytime a learner can open the email box to read solutions (opinions) of members in her/his group and then write his/her own suggestion. The system keeps the email boxes' content updated. When it is necessary or at the deadline, the instructor intervenes by giving some remarks, statistics, conclusion, animating the group and/or announcing a bonus.

4.2 The LINC components

The LINC system has three components with different functionalities and interfaces. The first component is a multi-user online authoring system, which allows at most six team's members (instructional designers) to collectively create the lesson's contents that include demonstrations (multimedia files) and referenced documents on the Web or preloaded on the server. This component is separated software, which has been used in several educational projects (Lê and Lamontagne, 2002, 2003). It allows to easily structure the lessons in a task-oriented fashion and to save them in the graphical knowledge networks (XML files). Each network (figure 1) includes several related nodes which can be clicked on to open a text frame (figure 5) with several slots. The last slot is reserved for the question, in which a good designer must layout a

suitable question that stimulates the reflection of the learners about the underlying subject matter. On the main interface (figure 1) with two course's designers (photos on the left), the first icon on the upper left which is the project management tool, gives the project team leader full control on the current project, e.g. he can create a new project (figure 3), and then add users and lessons to this project, and later edit users and lessons in the project editing interface (figure 4).

Another interesting functionality is the message board where designers can communicate with each other to accomplish their collaborative work by clicking on a display picture; if the display picture clicked represents the user oneself, she/he will then be able to send messages over the network. Otherwise, she/he can only read the messages.
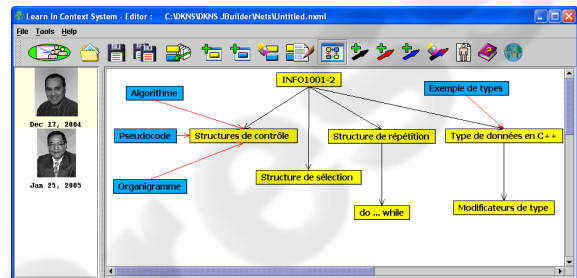

Figure 1: Example of a Knowledge Network

A user can also modify her/his own profile (Figure 2), i.e. her/his picture and password, by clicking on the third icon from the right in figure 1. During a working session, a user can only access her/his designated nodes. This control mechanism is set up by the team leader using the Control Access Table accessible for him only.
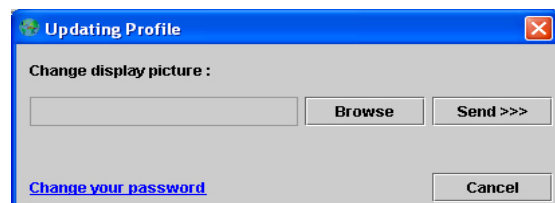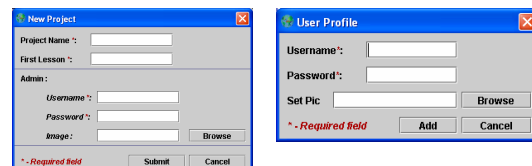

Figure 2: Profile updating interface

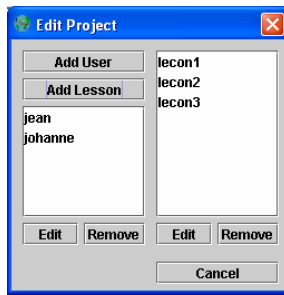Figure 3: Interfaces to add a new project and users

Figure 4: Project editing interface

The second component is a kind of Learning Management System, the platform in which online courses as well as accompanied files (teacher's photo, multimedia files) are assembled before the online dissemination.
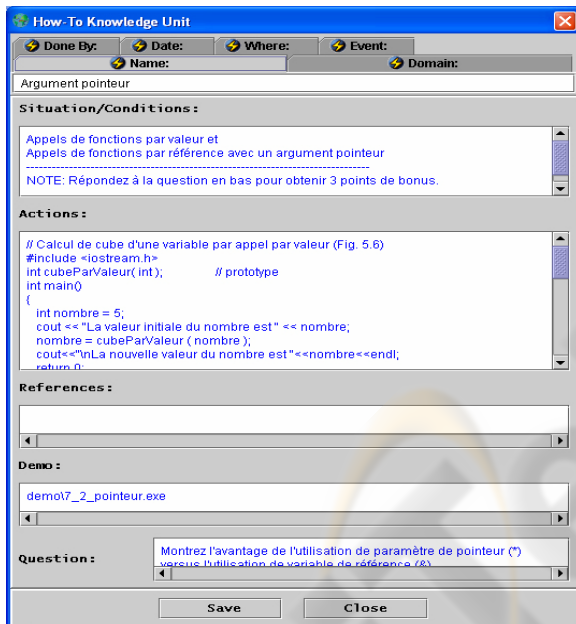

Figure 5: Example of a Text Frame

The third component is a tool that generates the Web pages by interpreting the xml files containing the learning material. The tool translates the xml files into "jsp" files and sends them to the web server. These pages are presented to learners via the Internet. Its interface has the form of a standard Web page with the index of the actual lesson at the left, which corresponds to the Knowledge Network illustrated in the figure 1, with the actual topic's content displayed at the right. In the Figure 6 one can see the hyperlink words "Reference" and "Demo" below the instructor's photo to display the referenced document and to activate the multimedia

demonstration (video clip, Flash file, etc.). There are also some highlighted words in the text; by passing the mouse over these words, a small yellow box will appear to explain the concept or to give a definition.

The forum for discussion between students can be opened by clicking on one of the six mailboxes icons labelled from "Group A" to "Group F". Figure 7 illustrates a window of exchanged messages from members of a group. We repeat that each mailbox's content is anchored to the corresponding topic of the lesson. Thus, we can lately trace the student's knowledge evolution.
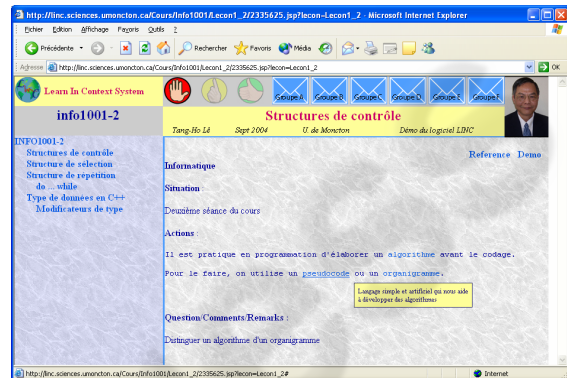

Figure 6: The LINC Learner's Interface

Finally, the three hand-icons are for the instructor's intervention when it is necessary. If the red Stop-hand icon is highlighted, the discussion is going too far from the underlying topic; the instructor gives then a sign to call back the learners. If the yellow Attention-hand icon is highlighted, the discussion may be in the wrong way, the instructor gives then some hints to help the learners. And when the green Good-hand is highlighted, the instructor encourages the learners to continue on the actual track or to promise a bonus, an award, etc. We note that his/her role in the case of a similar course is more suitable as animator, facilitator, and questioner, i.e. less important than the learner's role in the learning process.
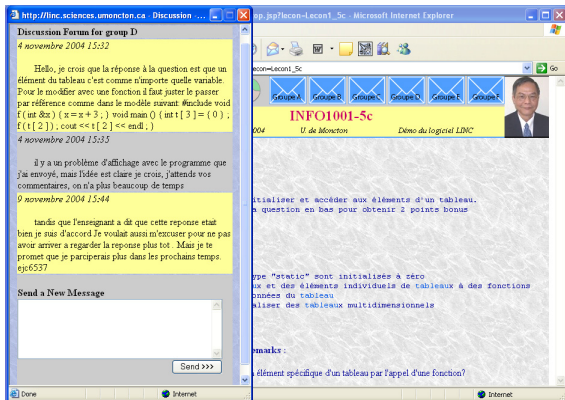
Figure 7: The LINC Learner's Forum

5 INITIAL EXPERIMENTATION AND RESULT

We have used this e-Learning tool in a trimester programming course of our university. We have created ten lessons using the authoring system and fifteen Flash files for the demonstrations accompanied each lesson. The course is given for thirty six students of the first year. In each meeting in the classroom, we access to the Web site and project the Web pages on a big screen. After the class, the students are encouraged to using the LINC at home or in laboratory to review lessons and to collaborate with the group's members to respond to questions by using the LINC's forum. There are six groups with six students per group. We consider the LINC as a new pedagogical resource allowing to enhancing the learning in the classroom. With this tool, we offer to students more opportunities to exchange their opinions on the subject matter. They can do that comfortably at home and at times convenient to them.

We know that a successful collaborative learning should be a problem-based learning. That is, the learners have to collectively resolve a concrete problem. However, the actual course is not a workshop, nor having some projects to be realized. Thus, it is difficult to motivate the students. We then try to do something similar to a problem-based learning by elaborating the appropriate questions for each lesson, and encouraging students to answer these questions. If a group has a right answer, all members in this group will benefice the same bonus.

In the first two weeks, the questions haven't bonus's promising, and because of the timidity (most the students don't meet together before the course) and some students have technical problem to access to the site, so any student participated to the forum. From the third week, we announced a specific bonus for each question. The participation rate then augmented day by day, from 30% to 70% and may be more now. Comparing with the past trimesters, we observed a relative profoundness in the learning. What is more evident is that the appointments we normally have with students are reduced, because they can now directly post their questions on the forum to other group's members. By following the forum, we also recognize the real knowledge level of students, and the more importance is that, through their messages, we can easily detect some misconceptions or misunderstandings about the subject matter; so we can clarify them in the next meeting.

At the end of the course, we had distributed a questionnaire to collect students' evaluation about this tool. Generally speaking, we state that there was the satisfaction of almost every student. With this result as well as the evident advantage for the instructor, we believe that the LINC software is very useful, to both learners and teacher, and thus, we confirm the two hypotheses mentioned above. In the next future, we plan to use it in more courses and we will have a full evaluation of it.

6 CONCLUSION

In summary, basing on some appropriate theories of learning and e-Learning, as well as on the lesson learned from the projects' experiences reported by several researchers, we have developed the LINC, a Web-based learning tool. This system presents lessons to learners with multimedia demonstration files, which are very necessary for the learning of procedural knowledge. In addition, there is a discussion forum integrated in the system, which allows six small groups of learners and an instructor to exchange messages related to every lesson's topic without leaving the learning context; this way can increase the learning effectiveness and avoid certain problems in the collaborative learning, at the same time, it encourages the competition between groups. The LINC is now in its experimenting phase of mixed-mode learning. The preliminary result is very positive. In a near future, we will report its deployment in more courses with the concrete results and data collection to effectively evaluate all other aspects of it.

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