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Indice

A Framework to Support Web-Based Inquiry-Learning Activities with WebQuests

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Abstract

WebQuests are among the most popular techniques to enhance collaboration in learning; they are an inquiry-based activity, grounded on constructivist learning theory, where the information that learners interact with are mostly found on the Internet. We present here a system that offers computer-support during a WebQuest, by offering the structured discussion and debate, besides the navigation and resource sharing. We integrate the WebQuest design process with an operational design phase and describe how our system can completely support the design of a computer-supported WebQuest.

Introduction

The richness and variety of information available to learners, nowadays, over the Internet is unprecedented in history and its usage in collaborative learning was evident. As an archetype way of using the Internet and the resources on the World Wide Web as learning tool,

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among the most popular ones, we find the WebQuest, "an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet, optionally supplemented with videoconferencing", according to the definition provided (Dodge, 1995, 2001) by its creator, Bernie Dodge (Dodge, 2009d).

WebQuests base their pedagogical ground on constructivist learning theory and have a considerable role in project-based learning and teaching in classrooms; there is a extensive repertoire of WebQuests (Chandler, 2003; Kelly, 2000): its success is documented by the "more than a decade"-long widespread usage (Lamb & Teclehaimanot, 2005).

Motivations

We present the technological design of a system that offers full and comprehensive computer-support during a WebQuest, by offering the structured discussion and debate, besides the navigation and resource sharing. We integrate the WebQuest design process with an operational design phase and describe how our system can completely support the design of a computer-supported WebQuest.

Our work is grounded on research recently conducted on WebQuests and their pedagogical effectiveness. First, Soloway *et al.* (2000) commented that, while WebQuests do represent an important starting point for younger students, it is also needed to place more emphasis on the discourse for learning, where cooperation around a WebQuest can be used for enlarging the experience with a "discourse" (debate) around the topic, that fosters fruitful learning. This observation is reinforced by the research by MacGregor and Lou (2004) that shows that instructional scaffolding and concept mapping templates engage students in a more fruitful WebQuest and by the considerations that, in general, in resource-based learning scenarios (Hill, 2001), students often suffer from cognitive overload and need scaffolding and cognitive tools to cope with complex task situations. Furthermore, some results (Ikpeze & Boyd, 2007) show an increasing need for supporting the collaboration and the social interaction during a WebQuest.

But our research was also motivated by the observation that within the WebQuest current practice computers are only used for browsing the Internet and assembling material to be published on the Web. Therefore, we want to foster the usage of computer-mediated communication during the WebQuest with the objective to enrich the WebQuest process with a structure that orchestrates and guides the interactions of students among them and with resources, in order to provide structure, scaffolding and guidance during students' activities. In our opinion, besides addressing the lack of debate and discussion around WebQuests (Soloway *et al.*, 2000) and the lack of sufficient scaffolding (MacGregor & Lou, 2004), computer-supported WebQuests also address some problems in the implementation of WebQuests: a computer-supported design (with a detailed planning of the process to be followed) and execution of a WebQuest, with an environment as CoFFEE (De Chiara, Di Matteo, Manno, & Scarano, 2007) allows structuring of interactions and collaboration among the students and can help unexperienced teachers in realizing/using effectively WebQuests.

Results

Methodologically, to address the technological design of WebQuests, we present the concept of operational design that is meant to organize the computer-support for a WebQuest. The operational design of a computer-supported WebQuest consists of four phases, namely, designing, authoring, executing and documenting a WebQuest. We will argue that support during each of these phases is a significant help to the teacher/designer of the WebQuest.

Then, we present a system providing computer-support for Web Quests. The system is based on CoFFEE (De Chiara *et al.*, 2007; Belgiorno *et al.*, 2008), a collaborative system supporting face2face discussions in the classroom. We developed two new tools to accommodate some tasks usually performed in WebQuests. Then, we show an example, taken from a well-known repository of WebQuests and show how it is conducted with our system.

It should be said that in this paper we are presenting an extended version of our preliminary work described in Belgiorno, Malandrino, Manno, Palmieri and Scarano, (2009).

WebQuests and their design

On the Web there are some attempts to provide a design process for a WebQuest but they are mostly focused on the pedagogical background, preparation and motivation, for which, of course, there is very little support a computer can provide. In this section, we propose an operational view of the design process of a WebQuest that is meant to identify the phases where the computer-support can help teachers in building new WebQuests. As pedagogical design process, we refer to the one provided into the WebQuest official site (Dodge, 2009c). The phases are depicted as follows:

1. Select a topic appropriate for WebQuests;
2. Select a design;
3. Describe how learners will be evaluated;
4. Design the process;
5. Polish and Prettify.

The output of the process is the (specific) WebQuest: a detailed and structured list of instructions (for teacher and students) to be followed for "executing" a WebQuest. In fact, a WebQuest, by definition, is to contain at least the following building blocks: (a) an introduction, to provide background information; (b) a task, that could be a problem to be solved or anything that involves the learners to analyze and transform the gathered information; (c) a process, that delineates the steps the learners should follow in accomplishing the task; (d) a set of evaluation criteria to evaluate the work accomplished by learners; (e) a conclusion, to inform the learners about their results and finally a teacher page, that could be useful for other teachers to implement WebQuests.

Our proposal is to augment the WebQuest scenario with the computer-support and, rather than using the computers only as

mere information seeker tool and editors, use the computer-support to orchestrate the whole set of activities, from the design and authoring of the WebQuest (from the teacher perspective) to the execution (searching for information but also discussing, debating and presenting) and documenting (from the student/teacher perspective).

In fact, our operational design process of a WebQuest is defined as composed by the following fundamental phases:

- *Design*, that is to help the teacher in choosing a pedagogically motivated template to use in classroom; the template contains not only introduction, task, evaluation criteria, but also a step-by-step executable sequence of cooperative actions to be performed by the students in a synchronous work session, each one using his/her own PC.
- *Authoring*, when the teacher fills-in the details of the topic found, by providing the topic and the base material (links, etc.). In this phase, adjustment of the template are possible (merging / splitting / creating new steps).
- *Execution*. This is the new phase that allows the cooperative work by the students to take place in a computer-supported face2face setting, where each student communicates and discusses both orally and computer-mediated while, at the same time, using the computer as information-seeker and note-taker.
- *Documenting* is the final phase that consists in publishing on the Web the results (in HTML) in such a way that the results of the WebQuest are publicly available.

Previous work

While a lot of useful resources are available on the Web to create WebQuests (Dodge, 2009d) and different tools are available to support online authoring and hosting services (Dodge, 2009a; Filamentaly, 2009; Temprano, 2005; TeacherWeb, 2009; Unal, 2007), no system is actually able to fully support the WebQuest process, by

lacking the computer-support in the execution of the WebQuest in the classroom.

QuestGarden (Dodge, 2009a) is an online authoring tool which allows to easily create WebQuest or bring a WebQuest written by another member of the community, customize and use it. It also supports resources hosting. The services provided by QuestGarden supports then the design, authoring and documenting phases of the operational design.

Filamentality (2009) is an online authoring tool developed as part of the AT&T Knowledge Network Explorer. It is a fill-in-the-blank tool that provides support for choosing a topic appropriate for a specific teaching activity, searching the Internet for useful resources and organize them in a well defined learning process. Finally, Web-based results can be hosted and shared with others. Then, Filamentality provides support in the authoring phase and in the documentation phase of the operational design.

zWebquest (Unal, 2007), PHPWebQuest (Temprano, 2005) and TeacherWeb (TeacherWeb, 2009) are online services specifically designed for quickly creating WebQuests. All systems provide a step-by-step support for creating, authoring and documenting Web-based inquiry activities. TeacherWeb provides support for organizing all information required to communicate with students and template Websites for teachers' use in the classroom. They represent WebQuests examples to guide authors in writing high-quality inquiry-based activities.

In general all the state-of-the-art tools share a common property, that is, they are fill-in-the-blank tools that guide authors through the phases of picking a topic, searching resources in Internet and documenting them into online learning activities. By leveraging on these systems authors can build WebQuests without knowing anything about HTML or how hosting Web pages. These activities encompass designing, authoring and documenting steps of the operational design of WebQuests. Conversely, the execution phase has not been envisioned and implemented by any system (see Table 1).

Table 1. Summary of tools comparison: a – symbol in the table means that the specific phase is not supported

	Design	Authoring	Executing	Documenting
CoFFEE	√	√	√	√
QuestGarden	√	√	–	√
Filamentality	–	√	–	√
zWebquest	–	√	–	√
PHPWebQuest	–	√	–	√
TeacherWeb	–	√	–	√

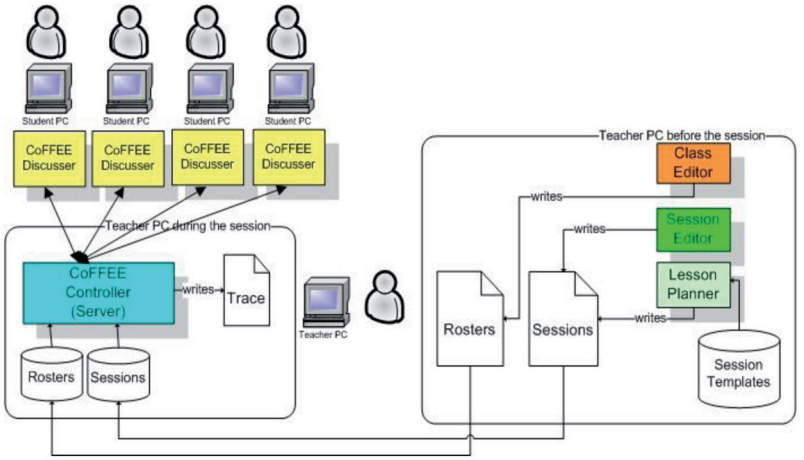
CoFFEE: synchronous collaboration

In this section, we briefly present the earlier work that served as a basis for the current result. CoFFEE is a groupware developed to support face-to-face collaborative problem solving and learning (De Chiara *et al.*, 2007; Belgiorno *et al.*, 2008; De Chiara, Manno, & Scarano, in press). The project was developed under VI FQ European Research Project "Lead" and is now available free and open-source on Sourceforge http://www.sourceforge.net/projects/coffee-soft while the international teacher support site is on http://www.coffee-soft.org.

CoFFEE Applications

CoFFEE is a suite of applications with different aims and usage context (Figure 1). The CoFFEE Controller and the CoFFEE Discusser are the main applications used by teacher and learners in classroom during the collaborative process. The teacher drives the collaborative process using a script named *session*.

Figure 1. The CoFFEE Suite



The session allows the teacher to structure the collaboration in a sequence of steps; within each step the teacher can split the classroom in groups; for each group the teacher can choose the desired tools among the set of available collaborative tools. The session is defined by the teacher through the Session Editor or the Lesson Planner.

The Session Editor allows to create a session from scratch customizing all the options and configuring all the details of the tools.

The Lesson Planner allows to create a session starting from a template. A session template provides the general structure of the collaborative process, as the number of steps

and the tools desired for each step. The template can be customized providing the argument and tasks of the collaborative process, and defining the number of groups in the group steps.

The Class Editor allows to create a roster of the students, eventually associating a password to everyone. The teacher can choose to ask students identification when starts the Controller.

CoFFEE Tools

CoFFEE provides a rich set of collaborative tools among which the teacher can choose the tools to provide to each group of students in each step. We have used in particular the Threaded Discussion, the Graphical, the Group Presence, the Private Notes tool and the Repository tool.

The Threaded Discussion tool (see Figure 2, left) is a synchronous discussion system where the contributions are structured as threads. The threads allows learners to create separate discussion branches keeping clearness about the several arguments. The tool is highly configurable: it is possible to use categories (building a discussion tree for each category) and to define contribution types to tag the messages (the teacher can define its own types following the specific needs of the current task).

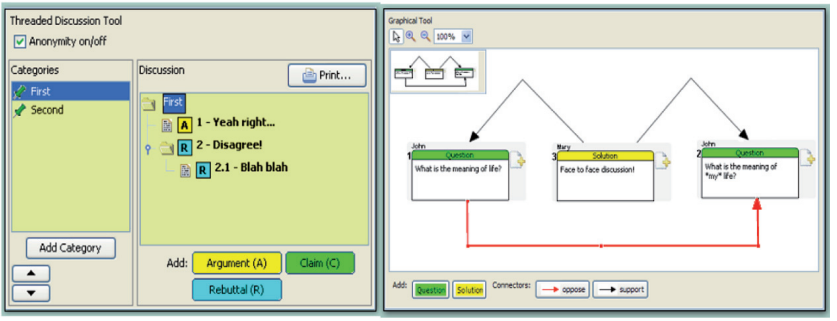
The Graphical tool (see Figure 2, right) offers a synchronous shared graphical space where the learners can create contributions as textual boxes as well as links between contributions. This tool is designed to support brainstorming processes and conceptual maps creation, but it is enough generic and malleable to satisfy other usage scenarios.

CoFFEE provides also other tools, like a Group Presence tool to provide presence and group membership awareness within the groups, a Repository where students can share resources (files) under the coordination of the teacher, a Private Notes tool to write some private textual notes and a Positionometer to support voting and giving one's opinion. Also a standard Chat is offered, as well as a CoWriter tool to allow cooperative writing with turn taking (i.e., just one user writes into the text at a time).

Computer-supported WebQuests with CoFFEE

Here we present how CoFFEE supports the operational design of a WebQuest, starting from the creation of a WebQuest by the teacher, passing through its execution in class and the final documentation of the results.

Figure 2. An example of the Threaded Discussion tool (left) and of the Graphical tool (right)



Design and authoring

The design and authoring phases of the operational design of a WebQuest are accommodated by the flexible scripting mechanism provided by CoFFEE (Belgiorno, De Chiara, Manno, & Scarano, 2008). The mechanism allows to provide a script (named CoFFEE session) that is followed by the teacher during the lesson, by using the Controller (see Figure 1).

The applications meant to facilitate the creation of sessions are the Lesson Planner and the Session Editor. The first one allows the teacher to select a predefined template, i.e. a session where the steps, the tools and their configuration are already set and the tasks and other simple details can be adapted by the teacher to create a session. If the teacher wants to modify details of the session (or create a session from scratch), the Session Editor can be used, that provides full control on each single configuration detail.

The pedagogical design phase is currently helped by the "instructionally solid" Design Patterns (Dodge, 2009b). Grouped in categories that follow high-level activities in the Bloom's taxonomy, the Design Patterns represent the pedagogical starting point to create a WebQuest. This is where the operational design comes on stage, since the provided WebQuest templates only give a coarse grain definition

of the process and do not encourage sufficient scaffolding. This is where we address the issues raised in MacGregor and Lou (2004) and Zheng *et al.* (2008) about structure and implementation by unexperienced teachers.

We leveraged on the Lesson Planner ability to provide CoFFEE-based templates and created the implementation of several known and pedagogically well-motivated design patterns taken from Dodge (2009b). As a proof of concept, we created templates for the following patterns: "Commemorative" (in the "Design tasks" category), "Comparative judgment" (from "Decision tasks") and "Behind the book" from the category "Creative Tasks"). They can be downloaded (with additional material) from „http://sourceforge.net/apps/trac/coffeesoft/wiki/CoFFEE within WebQuest' and imported into the Lesson Planner.

As shown in Figure 3, the teacher is supported by a narrative, wizard-like structure. First, the teacher chooses a CoFFEE template from the set shown. Then, the teacher can advance to the next step ("Edit"), where it is possible to instantiate the tasks and instructions

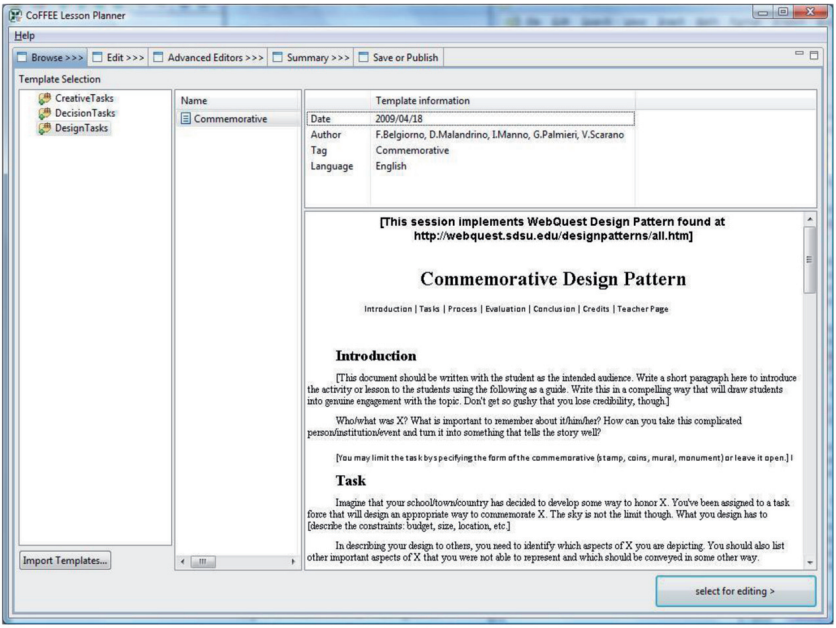
for each step. If the teacher is satisfied with the structure presented, he/she can move to the Summary and Save steps (tabs on the top). Otherwise, the teacher can choose the "Advanced Editor" tab, where the Session Editor gives the opportunity to change any detail. Of course, the Session Editor can also be used to author a session from scratch.

Executing a WebQuest

To support WebQuest we have developed and integrates into CoFFEE (thanks to its flexibility) two new tools that were not directly related to the discussion and debate but also on the Web browsing and resource sharing. Here we describe the new tools that we have developed: the InternetExplorer and the DocumentBrowser tool.

The InternetExplorer tool allows each learner to navigate the World Wide Web through a standard browser. It offers the standard functionalities of a browser, but also the opportunity for the teacher

Figure 3. The example of one of the WebQuests Design Patterns brought into Lesson Planner



to provide a "follow-me" mechanism so that the starting point of a navigation can be illustrated to the learners, but also avoiding the "free" surfing of the Web. The tool also offers, on teacher side, a repository of documents (HTTP server) where the students can freely browse or, if the "follow-me" is activated, then everybody's browser loads the same document.

The teacher-side of the tool allows the teacher to set/reset navigation mode at run-time, therefore changing instantaneously from synchronous ("follow-me") to asynchronous. In the synchronous mode, the teacher guides the navigation while, in the other mode, the learners can freely navigate the Web.

The DocumentBrowser tool is an HTTP server that allows the teacher to share documents with the classroom. The interface of the

tool consists of a Web browser which is automatically connected to the root directory of the HTTP server, in which the teacher have placed the documents. Both the teacher and the learners can open the documents and navigate the links within the browser, but no "free browsing" is allowed: no search function, no address input field, just the basic "back", "forward", "home" navigation functions. This should fit the requirement for a scaffolded process: the teacher addresses the search by providing the starting points for exploration, i.e. the initial documents and links.

The DocumentBrowser cannot be considered a "collaborative" tool (as most CoFFEE tools are), because each learner performs its own navigation independently from what the other learners do: this characteristic is essential to perform the personal tasks assigned to each learner. The collaborative part of the work, such as exchanging links and collecting ideas, can be done with the standard CoFFEE tools.

Documenting a WebQuest

The documenting phase of the operational design of a WebQuest enables the inquiry activities to be published on the Web. To this aim CoFFEE allows to export structured discussions (i.e., CoFFEE sessions) in PDF, RTF and HTML formats through the Controller (see Figure 1).

An example WebQuest

As described in Section 2, WebQuests are orchestrated around the following phases: introduction, task, process, evaluation criteria and conclusion. In order to prove the effectiveness of CoFFEE (equipped with the new tools) to deal efficiently with the WebQuests, we selected from the repository of WebQuests (available on http://www.webquest.org) an example WebQuest titled "Get your kicks on Route 66" developed by an Italian teacher of English language.

The task of this WebQuest is (as the author writes) the following:

"Your task will consist of planning a visit to Chicago, St. Louis or Los Angeles by finding detailed information on the Web. Your class will be divided into 3 groups and each of them will work on a different city. Every student will be in charge of finding information on a particular aspect of the city, so before you start you will need to assign roles within your own group. At the end, every group will create a Powerpoint presentation and in turn will show the project to the class."

The process of this WebQuest consists of 6 phases (we will use the term "phase" for the WebQuest and the term "step" for the CoFFEE session): the first one is to distribute within each group the tasks to be covered, i.e., History and Culture, Sights, Museums, Parks/Entertainment, Shopping/Eating out. The second phase is to use the resources provided (a set of links) for each task that each student must cover. In the third phase, each student can take notes and gather information. In the fourth phase, the material has to be analyzed and shared with the other students that in the other groups cover the same section (this is similar to the Jigsaw approach (Aronson, Blaney, Sikes, Stephan, & Snapp., 1978) and with your team so that the information can be placed together. Phases 5 and 6 require to plan, with the group, the Powerpoint presentation and then show the presentation to the rest of the class.

The session in CoFFEE is presented in Table 2, where the "steps" are referring to CoFFEE session steps. In Figure 4, an example is shown. Here John, that belongs to the "Chicago" group, has on the right-hand side the DocumentBrowser tool that allows to start with the suggested resourced (by the teacher) and to navigate the resources on the Web. In the previous step, John has been navigating and taking private free-text notes, while now he can arrange the notes for the following discussion. It should be noticed that the private tools are exactly the same as public tools, but the behavior is personal, and the background of the tool is shown in light blue. Also, the material of the previous steps is still accessible (read-only) by the student.

In Figure 5, the view from the teacher side is shown. In fact, in addition to the "learner view", the teacher also has the Control Panel to manage the classroom (groups composition, block/activate a specific

Figure 4. The private work by John, to organize the material he worked on in Step 2 about Chicago

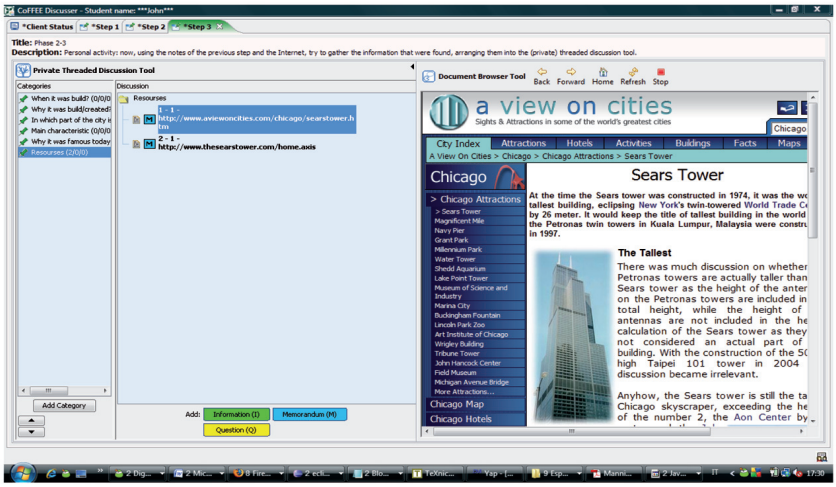
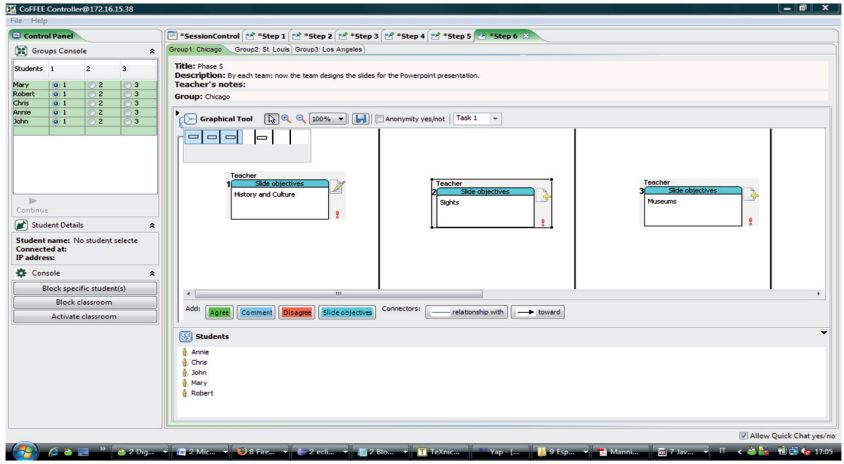


Figure 5. The design of the presentation: each slide is a box in the graphical tool, accessed in parallel by all the participants, but comments and relationships can be placed among boxes on the graphical space



student/the classroom). In this step, the Graphical tool is used in parallel by each member of the same group (here we see the Chicago group) to plan the presentation for each task (vertical column).

In Step 7, the Repository tool is used for sharing the Powerpoint presentations. The teacher can access all the personal folders of the students and place them in the Shared folder where all the members can access them.

Some comments on the session (Table 2) and the role of CoFFEE are needed: the flexibility exhibited by CoFFEE is crucial in managing a WebQuest with the adequate mix of intrinsic and extrinsic constraints (as called in Dillenbourg and Tchounikine (2007), i.e., the pedagogically motivated versus the technologically or logistically motivated constraints. In fact, the flexibility of CoFFEE in dealing with a session that spawns multiple meetings as well as its versatility in assembling group and global steps, represent an important factor in the effective representation of a WebQuest.

Table 2. The CoFFEE session to realize the WebQuest on Route66. "Phase" refers to the WebQuest process while and "Step" refers to the CoFFEE session

Phase	Step	Tools	Task Description // Tools Configuration and Usage
1	1	Threaded DocumentBrowser Presence	By each team: Distribute the 5 tasks among your team. Read the chart that describes the information to get for each task.
			The discussion about the distribution ofthe tasks happens through the threaded discussion tool. The DocumentBrowser is used to read the chart.
2	2	DocumentBrowser Notes	Personal activity: use the resources provided to explore the Internet to find the information required and take notes of the most relevant information found.
			The Notes tools is a private text-editor, that will be accessible to each learner also in the successive steps, for copying and pasting material, or for reading.

2-3	3	Threaded DocumentBrowser	Personal activity: using the notes of the previous step and the Internet, try to gather the information that were found, arranging them into the (private) threaded discussion tool.
			The threaded discussion tool is configured as private, so that each learner can use it to structure his/her information around the task.
4	4	Threaded DocumentBrowser Presence	Learners with the same task (i.e., "Museums") are grouped together. They discuss together the material they have found.
			The threaded discussion tool is configured with the categories, that can be added by the learners, so that the discussion is suggested to happen along the guidelines provided by the chart of step 1.
4	5	Threaded DocumentBrowser Presence	By each team: now the team discusses the material found and try to pull the information together. The discussion should try to emphasize the relationships among the materials so that they are homogeneously arranged and (successively) presented.
			The threaded discussion tool is configured with the categories, that can be added by the learners, so that the discussion is suggested to happen along the guidelines provided by the chart of step 1.
5	6	Graphical DocumentBrowser Presence	By each team: now the team designs the slides for the powerpoint presentation.
			The Graphical tool is to be used for the design, with the space partitioned in five columns: in each column there will be one of the task (which is the way the presentation will be subdivided).
5-6	7	Chat Repository Presence MS Powerpoint (non CoFFEE)	By each team: the learners of each team will prepare the Power point presentation and will deliver it. Each learner will prepare his/her few slides and will submit it to the group repository.
			The chat will be used for the meta-task coordination. It is relevant to notice that the previous steps material can be accessed read-only.

Conclusive remarks

In this paper, we, first, motivated the introduction of computer-supported WebQuests in order to address issues of introducing debates in inquiry-based activities (Soloway *et al.*, 2000), placing more structure and scaffolding into WebQuests (MacGregor & Lou, 2004) and facilitating their fruitful implementation for unexperienced teachers (Zheng *et al.*, 2008). We, then, presented a system to computer-support WebQuests from the creation to the publication phase. The system is based on CoFFEE (De Chiara *et al.*, 2007; De Chiara *et al.*, in press) but required two new tools to be introduced and integrated into the system. We also showed a operational design process that is completely supported by the system we present and exhibited an example of application of CoFFEE sessions to implement WebQuests.

Several other characteristics of CoFFEE are, indeed, useful for WebQuests and are worth mentioning. First, the execution of a Web Quest by CoFFEE is entirely logged in an XML file, that can be reopened, by the Controller and by the Replayer. The Replayer allows the teacher to analyze step-by-step the whole process performed by the class, while the Controller allows the teacher to access to the whole discussion as it happened, all at once.

Another good characteristics of CoFFEE is its flexibility that allows the teacher to easily manage unexpected events during the WebQuest. For example, it is possible pausing a CoFFEE session and resuming it at a later time. Moreover, CoFFEE flexibility allows the teacher, while the WebQuest session is running, to add "on-the-fly" new tools, that run "externally" to the step and can serve extemporaneous, unaccounted-for needs during the session.

As future work, we are planning to add even more versatility and flexibility to CoFFEE. In fact, now all the groups are bound to advance to the next step together. We are considering to allows advancing groups to a next step at different times. We are also facing some technical constraints that have limited the availability of CoFFEE to local area networks, so that CoFFEE would be available to support remote collaboration.

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