# An online Collaborative Environment for the Learning of Basic Issues of Telecommunications and Computer Networks: Exploiting the Tools of LAMS and Web 2.0

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*Abstract*—**This paper presents an innovative description of a collaborative learning method within the context of open source learning design environment such as LAMS [1] , with special reference to the learning of essential issues in the area of telecommunications and computer networks. The innovative description of collaborative learning methods in this paper within LAMS is based on the fact that (a) the Jigsaw collaborative method [2] is used in combination with the 'One minute papers' [3] collaborative strategy (b) Web 2.0 tools are proposed to be used in the context of LAMS (c) the tasks assigned to students consist of investigation of real world scenarios and not merely the study of learning material as is usually proposed, (d) for the design of collaborative learning activity, an intuitive learning design tool like LAMS is used, and (e) the use of the Jigsaw method within LAMS for the learning of the aforementioned issues has not yet been reported.**

*Index Terms*—**Collaboration, LAMS, Web 2.0, Telecommunications, Computer Networks**

## I. INTRODUCTION

It is widely accepted that e-learning has opened new horizons in education, freeing learning from the constraints of place and time while at the same time offering educators and learners valuable tools that can enhance the learning process of each learning subject [4] - [5]. Nevertheless, a basic requirement for an effective educational procedure is the evolution from a spontaneous activity to a well organized and structured sequence of activities in an environment providing appropriate capabilities [6]. The advantages of the application of collaborative methods in the educational process have been acknowledged in several academic research papers. In fact, the cultivation of the feeling of motivation, the energetic commitment of the students in the educational process [7], the expansion and deepening of the learning experience, the adoption of new approaches in learning [5], the activation of the perceptive ability [8], the interaction in a social environment and the development of feelings of community

even in a web based learning environment [9] are some of the advantages of collaboration used in educational settings. Despite these advantages, initially there was a hesitance in the adoption of collaborative learning methods in educational procedures by the teachers [10].

To encourage teams to achieve effective collaboration, some amount of structuring may be necessary [11] - [12]. One way to structure collaboration is through the use of computer-supported collaborative design patterns. A pattern is seen as something that will not be reused directly but can nevertheless assist the informed teacher to build up their own range of tasks, tools or materials that can draw on a collected body of experience [13]. The idea of using collaborative learning patterns is combined with e-learning environments supporting the principles of "Learning Design". Referring to the term "Learning Design", it is defined as a description of teaching and learning taking place in a learning unit like a classroom lesson or in every well organized learning activity [14]. An important aspect of this definition is that the pedagogical approach being used is independent from the applied content and context. In this way, several successful pedagogical models can be shared and reused facilitating the comprehension of several learning subjects. However, the importance of active participation of educators in the design of learning scenarios is considered as crucial [15]. The importance of offering user friendly tools in educators to facilitate the process of learning design has also been emphasized [16] - [17]. However, teachers need high level tools with specific educational content in order to understand the meaning of Learning Design [15]. An example of such a tool is the well known learning environment, LAMS [1] that can effectively support the idea of learning design. Nevertheless, Dalziel [1] remarked on the lack of tools supporting efficiently collaborative activities. To this end, recently, a number of collaborative learning patterns have been designed within LAMS [18] – [19].

Especially when it comes to Computer Science (CS) Education, educators have adopted a rather deficient approach to 'learning design' in general [20] – [21] and to 'collaborative learning design' in particular [19], possibly because CS Education is a recently-developed scientific discipline. In

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truth, CS teachers require more specific support in their learning design practices, such as specific tools and good examples of lesson plans. Thus, CS teacher encouragement and support for learning design is clearly needed.

Taking into account all the above, we have attempted to form the 'Jigsaw' collaborative method [2] as a collaborative design pattern within the context of LAMS to construct a sequence of learning activities about essential issues in CS for high school students and especially for issues concerning the telecommunications and computer networks such as:
(a) the evolution phases of telecommunications,
(b) the evolution phases of computers and networks,
(c) the usefulness of telecommunications and computer networks,
(d) the usefulness of Internet,
(e) the inner details of networks operation, and
(f) the future network evolution and the integration of provided services.
Such a sequence of online collaborative learning activities for the learning of the aforementioned concepts in CS by secondary level education students - using the Jigsaw method within LAMS- has not yet been reported.

In fact, this paper contributes to the Jigsaw method being used: (a) to support students in performing investigations in the real world rather than dealing with specific text-based learning materials, as has been the case in other studies (b) in combination with the 'One minute papers' collaborative strategy (c) within LAMS and (d) to support sequences of online collaboration activities for the learning of the aforementioned issues in high school CS. High school teachers could implement this activity in their real practices in the context of high school curricula dedicated for the learning of CS concepts. Furthermore, designers of e-learning contexts could exploit the main ideas and the structure of the aforementioned educational activity to form other activities for the learning of various concepts included in school curricula.

In the next section of this paper, a brief description of LAMS and its basic tools is presented, followed by a description of the Jigsaw collaboration method. Then, a sequence of online collaborative learning activities using Jigsaw-within-LAMS with special reference to the aforementioned issues in high-school CS Education is demonstrated. Finally, the design of this sequence is discussed and conclusions and future research plans are drawn.

## II.  LAMS AND COLLABORATIVE LEARNING METHODS

### A.  LAMS

Lams (Learning Activity Management System ; http://lamsfoundation.org) is an open source learning environment offering sophisticated tools for the design, management and performance of online collaborative learning activities. LAMS [1], offers a set of predefined learning activities that are displayed to users in a simple and intuitive manner. The main philosophy integrated within LAMS is that knowledge is not produced only from the interaction of students with the educational material, but also, from the interaction of students with their educator and their peers. The creation of these sequential learning activities in which groups of students are participating and interacting in a structured way is known as learning design, which is something that we will rarely meet in e-learning environments. LAMS also enable educators to design, deliver and support learning sequences in a practical and intuitive way. Additionally, LAMS offers tools that support a great variety of learning activities. In the next session there will be a short description of the LAMS tools being used for the design of the proposed activities in this paper.

The *assessment* tool: allows the formation of a series of questions with great flexibility in such a way so that the weight is attributed in each question.

The *chat tool*: enables the synchronous discussion between the students.

The *chat and scribe* tool: combines the chat and scribe activities to display the full summary of a logged discussion, result of a given question.

The *forum* tool: offers an asynchronous discussion environment for students with the discussion issues posed by the educators.

The *forum and scribe* tool: combines the forum and scribe tools to display all the given answers for a specific subject.

The *mind map* tool: enables educators and students to design, modify and study mind maps in the LAMS environment.

The *multiple choice* activity: allows the creation of automatic assessment questions like multiple choice or true or false.

The *notebook* tool: could be used for the recording of students' opinions and comments during their involvement in the proposed learning activities.

The *noticeboard* tool: offers a simple way to support students with information and content in various forms: like text, pictures, hyperlinks and html packaged content.

The *question and answer* activity: enables educators to pose questions to the students. After each student's response, the students may see their colleagues' responses collected in a cumulative report.

The *share resources* activity: enables educators to add content in a sequence, such as hyperlinks, compressed webpages, files even learning objects. The LAMS environment enables teachers to add resources in real time.

The *submit files* tool: enables students to submit files to the central repository, easing the examination and correction of students' assignments by the educator.

The *survey* tool: presents students a series of questions collecting their answers which are displayed only to the teacher. The answers can be characterized as right or wrong.

The *wiki* tool: enables writers to create linked content pages

and optionally enables students to collaboratively modify the displayed content.

## B. The Jigsaw Collaborative method

The Jigsaw method [2] is considered to be a strategy that can effectively support collaborative learning scenarios and collaborative learning interactions especially in multicultural learning environments. Several researchers have proposed the application of this method within online learning environments [22], [18], [19] despite the fact that the Jigsaw method was initially proposed as a suitable method for face to face educational activities.
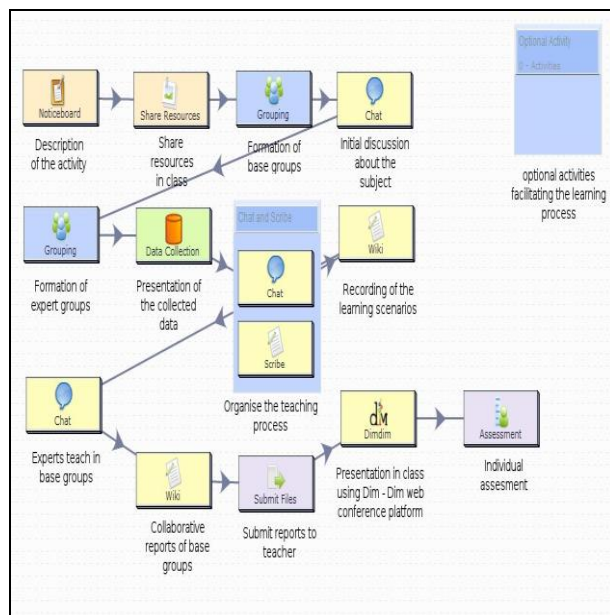


Figure 1. Diagrammatic representation of the JIGSAW collaborative method within LAMS

In more details, the Jigsaw learning method can be divided in the following phases: 1) Analysis of the given learning subject in well defined subparts, 2) Formation of the initial heterogeneous base teams (ideal size 4 - 6 students). Assignment of the role and learning subject for each student: each student has to take over the role of the expert trying to comprehend the assigned part of the learning subject in question, 3) Formation of expert groups consisted by students that have taken the same part of the learning subject. Each expert group has the task to study in depth their part of the learning subject and additionally, to design how to provide an interesting and efficient learning experience when they will return to their base teams, 4) Experts return to their base teams, 5) There is a final assessment phase where the students' understanding is tested on the whole parts of the learning subject in question. A diagrammatic representation of this method –as a design pattern within LAMS- is presented in Figure 1. Specifically, during phase 1, students will be informed about the whole activity using a *Notice board* and also will be provided with appropriate learning materials using

the *Share resources* tool. The *Grouping* tool will be also used for the formation of base groups (Phase 2). The *Chat/forum* activities could also be used to help students decide which specific expert group they like to joint. For the formation of the expert groups, the G*rouping* tool, will be also used (Phase 3). The *Data Collection* tool could be used for data collection by each expert group while the *Chat/forum* activities could be used for sharing ideas about the organization of the teaching process. The *wiki* tool could be used for the formation of the learning scenarios that could be realized by the experts when returning to the original groups. Next, the *Chat/forum* activities could be used for the realization of the aforementioned learning scenarios (Phase 4). Finally students' assessment (Phase 5) could take place through writing group reports (using the *wiki* tool), submit these reports to the teacher (using the *Submit files* tool) and presenting these to the whole class by using the *Dim-Dim* videoconferencing system. Students' individual assessment could be realized by using the *Assessment* tool.

## C. The One Minute Papers Collaborative method

The One-minute papers [3] is a quick and easy assessment tool that helps teachers to identify where misunderstanding occurs, while it also gives learners an opportunity to test their comprehension. It can also be used as a reflective tool to encourage learners to correlate their personal representations with the newly acquired knowledge. The goals of this method are to encourage students develop their meta-cognitive skills, to facilitate discussion between members of the team as well as to collect feedback about the comprehension of a learning material or a teaching procedure.
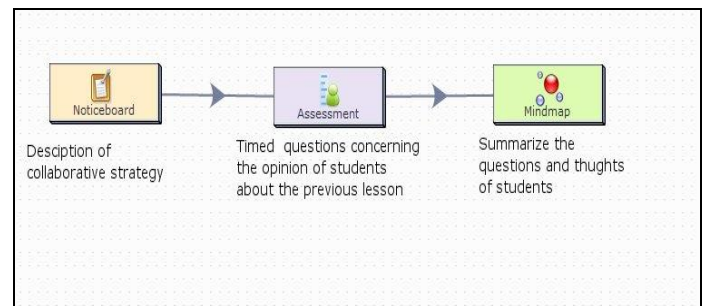


Figure 2. Implementation of One Minute Papers as a design pattern within LAMS

Process: 1) Teacher describes the One Minute paper strategy to the students (using a *Notice board*). 2) The students comment on the most useful things they have learnt and what they want clarified (using the *Assessment* tool). Teacher gives students 1 minute to express themselves, 3) Teacher presents the main questions from the students (using the *Mind mapping* tool). A diagrammatic representation of this method –as a design pattern within LAMS- is presented in Figure 2.

III.   Design of the collaborative activity for the learning of essential issues of networks and communications

The designed learning sequence consists of the following phases, 1) Introduction to the learning activity, 2) Formation of the initial groups, 3) The formation of expert groups, 4) Return to base teams, 5) Submission of the group report, 6) Presentation of group reports, 7) Assessment. It is noteworthy that the suggested sequence can be adapted to be used in synchronous and asynchronous educational environments. The only modification that is needed is the replacement of the chat tool with the forum tool and vice versa.

### A.   General description of the educational activity

The main goal of this educational activity is to encourage students to inquire essential issues concerning the telecommunications and computer networks, through the interaction with a collaborative learning environment. Desirable goals include the comprehension of issues regarding:
   1) the evolution phases of telecommunications,
   2) the evolution phases of computers and networks,
   3) the usefulness of telecommunications and computer networks,
   4) the inner details of networks operation,
   5) the usefulness of Internet,
   6) the future network evolution and the integration of provided services.

Additionally, through the students' effort to fulfill the learning goals, some side skills can be cultivated, like:
   (a) Practice with word processing and slide presentation software,
   (b)Familiarization with web search engines functionality,
   (c) Acquaintance with Web 2.0 tools helping in the improvement of expression and critical abilities.

Finally, it should be mentioned that the students' acquisition with new ways of teaching in environments which support the inquiring and collaborative learning, is crucially important.

To achieve the aforementioned learning goals, the organization of the class in groups where each one of them has to study a well defined subject, is suggested. An efficient organization of teams could be the following:
   (a) Communications group
   (b) Computers network group
   (c) Internet Group
   (d) Mobile network group

For a more thorough and interesting collection of information, the student groups should not to be limited in the usual search process in libraries or Internet. Each team is encouraged to collect data from real world places where communications and computer networks are used, like: (a) a financial organization e.g a bank, (b) a telecommunication provider, (c) a mobile telecommunication provider, (d) a university lab specialized in

computers' network research, and (e) an IT company dealing with the design and the installation of computer networks.

### 3.1. Phase 1: Jigsaw: Introduction to the activity

In this first phase, the students are informed through the use of Noticeboard about the context of the proposed activity. The main educational goals are presented, the issues that the students have to face are drawn out and the sources they have to search to find information about the subject to be learned are provided. Students can exchange their opinions using the chat or forum tools.

### 3.2. Phase 2: The formation of base groups

Here, students are grouped randomly in groups of 5 students. Initially, each team discusses the presented issues in the Noticeboard to form a mutually accepted framework of ideas regarding the part of the subject they prefer to study. In case of dispute, the teacher can assign roles to the students by himself. Alternatively, an assessment phase can be inserted -in sequence- before the formation of groups. The aim of this phase is to assess the prior knowledge of students in order to form more representative teams. Of course, there is also the choice to randomly form groups by using the random grouping tool of LAMS.

### 3.3. Phase 3: Formation of expert groups

Each member of the base teams has to specialize in one of the aforementioned issues by participating in one expert group where all students are occupied to study a well defined subject. Through the bibliographical research and the visiting of the aforementioned real life areas where networks are used, the expert groups should try to form a complete view about the subject they study. Complementary, the students may use social bookmarking tools to avoid unnecessary research in web pages that other colleagues have already visited. Each group has to study a well defined subject that will be described in more detail in the next section.

*The Jigsaw Communication Group* has to study the historical evolution of telecommunications. The students may focus on the telephone network and the different technologies being used throughout the years. The visit in the facilities of a telecommunication provider can help students to come in touch with the current technologies (their evolution and usefulness) used in telecommunications networks.

*The Networks Jigsaw Group* may study the inner details of networks operation, the different types of networks, the different topologies, the provided data rated and the possible applications of computer networks. A university lab or an IT company can offer students useful information about this subject.

*The Internet Jigsaw Group* may study issues regarding the services offered in Internet and the way it has altered the daily

life of common people. Students may explore details about the structure and the technologies behind the function of the Internet. Applications like e-commerce or e-banking can be studied in a financial organization like a bank.

*The Mobile Network Jigsaw Group* is researching on the future development of telecommunication technologies and the integration of data and voice networks. A visit to an IT Company and a university professor may provide students with interesting information about the future directions that this technological area may follow.

The visits of students can be combined with the production of multimedia content that can be recorded with the use of digital equipment like photo and video cameras. This multimedia content may stimulate students to further discuss what they've discovered in the web based classroom. The collected data can be categorized according to specific criteria selected by the students or the educator. If the educator observes that there are questions or misunderstandings, she/he can add material or activities -in real time- to help students better comprehend the learning subject in question. The Live Edit function of LAMS offers such capabilities.

Except the data collection and processing, the expert groups have to organize an interesting and efficient teaching procedure to share their knowledge and experience with their colleagues after the return to their base groups. The exchange of ideas and proposals about the teaching process being followed by the expert groups will be based on the use of the forum and chat tools. The wiki tool may be able to provide students with suitable representations and activities helping them to achieve a better comprehension of the learning subject. Optionally, the students can use an external blogging tool in which they may write down the daily evolution of their work. This unusual for the daily school life activity is enough to keep the students interested in their school work [23].

### 3.4. Phase 4: Return to base groups

Each expert returning to his base team has to use alternative ways to teach, encouraging students' interest and reinforcing the critical thinking of students. The main communication mediums among the expert and other students are the chat and forum tools. The main objective of teaching has to be the active involvement of the students in their learning with a main goal to understand and not to memorize the learning issues in question. During the educational activity, each student can ask the teacher to add complementary material or activities to help other colleagues to better understand the learning subject. To this end, it is worth noting that the participation of students in the design of educational activities within the context of LAMS has presented encouraging results [24].

### 3.5. Phase 5: Group report writing

Each group has to prepare a report that will be submitted to the teacher. In this context, the wiki tool can be used to present each student contribution and the log diary of wiki report. The final report may be formatted in a word processor and be submitted to the teacher using the "File Submit" tool.

### 3.6. Phase 6: Group report presentation

In this phase, it would be useful for students to be given some instructions and directions about the preparation of an interesting and comprehensive presentation. The web based presentations can be performed using the whole class forum or chat tools or by using a web conference platform like Dim – Dim that can be integrated within LAMS. During the web conference the educator can initiate a question and answer session to trigger a fertile discussion pushing the experts to present their expertise with more details.

### 3.7. Phase 7: Assessment phase

Here, the teacher can use the tool of assessment to test the level of students' comprehension. The offered tool supports several types of questions giving the teacher flexibility to form appropriate questionnaires. Additionally, the teacher can use the 'One minute papers' technique [3] to expand the questions so as to gather information about students' possible misunderstandings or their future interests. The goal of such questions is to develop students' metacognitive skills and reinforce the feeling of participation in the formation of future teaching sessions about this learning subject.

## IV.  SUMMARY AND CONCLUSIONS

In this paper, an online collaborative activity was presented for the learning of essential issues of networks and communications by secondary level education students (17-18 year old). The main educational goal of this activity was to provide students with opportunities to understand the development phases of networks and communications, to explore the functionality and the applications of the Internet and to study the future developments on the networks area. The key tool for the development of this educational activity was the "Learning Design" tool LAMS in combination with the optional use of Web 2.0 tools. The selected pedagogical approach was based on traditional classroom techniques like 'Jigsaw' and 'One Minute Paper' in combination with educational material collected by students after collaborative research in the Internet, libraries and areas of daily life where computers and networks are used. For a further evaluation of the proposed collaborative learning activity, a further research on real web based classes is needed.  In fact, a research study could be realized using real students where high school teachers could evaluate the aforementioned activity by integrating it within the context of CS courses dedicated for this level of education. As a result of such evaluation study, possible problems related to the implementation of this learning activity could be addressed and appropriate improvements could be realized.

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