THE JIGSAW COLLABORATIVE METHOD WITHIN THE ONLINE COMPUTER SCIENCE CLASSROOM

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Abstract: This paper presents an innovative description of the Jigsaw collaboration method within the context of open source e-learning 'Learning Design'-based systems such as LAMS, with special reference to the learning of essential issues in Computer Science. These issues include: (a) the wide range of computer technology used in daily life and the consequences of such utilization, (b) the variety of computer systems serving different tasks, (c) the dynamic evolution of information technology in our times. The innovative implementation of the Jigsaw method within LAMS is based on the fact that (a) the tasks assigned to the expert groups consisted of various investigative activities within the real world -where computers are used- and not merely the study of various learning materials as is usually proposed (b) for the design of the whole collaborative activity, the intuitive 'learning design'-based online tools provided by LAMS were used.

1 INTRODUCTION

E-learning has been widely acknowledged as a promising approach in education, providing flexible opportunities for learners to overcome time and space constraints on their learning, to enjoy virtual communication and collaboration throughout the world, to perform various and new types of interactions, and to encourage new forms of learning (Harasim, Hiltz, Teles & Turoff, 1995; Van Eijl & Pilot, 2003; Pallof & Pratt, 2004; Roberts, 2005; van Diggelen and Overdijk, 2009). Most importantly, e-learning demands careful planning of all learning activities deemed necessary during a lesson or a course. In fact, within e-learning contexts, teaching cannot be performed as a spontaneous activity but as a conscious and carefully-planned procedure.

Research in e-learning points out that involving learners in online collaborative learning activities could provide them with essential opportunities, such as: motivation for active engagement in their learning (Scardamalia & Bereiter, 1996), to extend and deepen their learning experiences, to try new ideas and improve their learning outcomes (Picciano, 2002; Pallof & Pratt, 2004), to trigger their cognitive processes (Dillenbourg, 1999), to enhance their diversity in terms of the learning concepts in question (Johnson and Johnson, 1994) as well as to interact socially and develop a sense of community and of belonging online (Haythornthwaite, Kazmer, Robins, & Shoemaker, 2000). On the whole, computer-supported collaborative learning has been recognized as an emerging paradigm of educational technology (Kosschmann, 1996). Despite this, many teachers remain unsure of why, when, and how to integrate collaboration into their teaching practices in general as well as into their online classes (Panitz, 1997; Brufee, 1999).

To this end, it is worth differentiating collaborative from cooperative learning situations. In cooperative settings, the task is split into subtasks and each participant is responsible for solving a portion of the problem at hand, while in collaborative situations, the participants are mutually involved in shared activities; they must coordinate their efforts if they are to solve problems together. In cooperative settings, learners usually produce separate solutions, whereas in collaborative learning, constructing a shared solution is essential (Liponen, 2002). To encourage teams to achieve effective collaboration some amount of structuring may be necessary (Lehtinen, 2003; Lipponen, 2002). 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 assist the informed teacher to build up their own range of tasks, tools or materials that

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can draw on a collected body of experience (McAndrew, Goodyear & Dalziel, 2006).

The idea of using specific collaborative patterns could be well integrated into '*learning design'*-based e-learning environments. A 'learning design' is defined as the description of the teaching-learning process that takes place in a unit of learning, e.g. a course, a lesson or any other designed learning event, such as a specific collaboration structure (Koper & Tattersall, 2005). An important part of this definition is that pedagogy is conceptually abstracted from context and content, so that excellent pedagogical models can be shared and reused across instructional contexts and subject domains. Specifically, best pedagogical practices can be reflected in the formation of '*design patterns'* which are context free and could be shared and reused across instructional contexts and essentially assist online learning. The key principle in 'learning design' is that it represents the learning activities that need to be performed by learners and teachers within the context of a unit of learning. In the context of "learning design', the role of collaborative design patterns is to indicate clearly the flow of collaboration activities using specific collaboration structures.

The IMS Learning Design (LD) specification aims to represent the design of units of learning in a semantic, formal and machine-interpretable way (LD, 2003). Various examples of e-learning environments close to the LD specification have been mentioned in the literature. However, authoring using LD is not a simple task for teachers as they are familiar with neither the use of the tools provided nor the underlying concepts of the LD modeling language to be taken into account when planning educational activities. However, involving teachers in not only the implementation but also the design of their teaching sessions is considered essential (Griffiths and Blat, 2005). To this end, the essential role of suitably-designed tools in supporting teachers in their mindful and appropriate 'learning design' has been acknowledged by many researchers (Lloyd & Wilson, 2001; Babiuk, 2005; Kordaki, Papadakis, & Hadzilakos, 2007; Kordaki & Daradoumis, 2009). It seems clear that teachers need high level tools to understand learning design and it is likely that tools specialized for a particular pedagogic context will be easier to use (Griffiths & Blat, 2005). To this end, it is worth noting that the type of editor that classroom teachers usually need should be similar to authoring environment provided by LAMS (Dalziel, 2003),a well-known integrated e-learning system that effectively supports the idea of 'learning design'. Recently, a number of collaboration design patterns have been constructed using the tools provided by LAMS (Kordaki & Siempos, 2009; Kordaki, Siempos & Daradoumis, 2009).

Especially when it comes to Computer Science (CS) Education, educators have adopted a rather deficient approach to 'learning design' in general (Kalyva, & Kordaki 2006; Kordaki, Papadakis, & Hadzilakos, 2007) and in 'collaborative learning design' in particular (Kordaki, Siempos & Daradoumis, 2009), possibly because CS Education is a recently-developed scientific discipline. In 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 (Aronson, 1971; Aronson, Blaney, Sikes, Stephan & Snapp, 1978) as a collaborative design pattern within the context of LAMS to construct a sequence of learning activities for essential issues in CS such as: (a) the wide range of computer technology used in daily life and the consequences of such utilization, (b) the variety of computer systems serving different tasks, (c) the dynamic evolution of information technology in our times. Such a sequence of online collaborative learning activities for the learning of CS concepts - 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) within LAMS and (c) to support sequences of online collaboration activities for the learning of the aforementioned issues in CS.

In the following section of this paper, the essential features of LAMS are briefly presented and 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 CS Education is demonstrated. Finally, the design of this sequence is discussed and conclusions and future research plans are drawn.

2 A FEW WORDS ABOUT LAMS AND JIGSAW

2.1 LAMS

LAMS (Learning Activity Management System; http://www.lamsfoundation.org/) is an open source tool for designing, managing and delivering online collaborative learning activities. In fact, LAMS offers a set of predefined learning activities, shown in a manner comprehensible to teachers, that can be graphically dragged and dropped in order to establish a flow chart of sequence of activities. When using LAMS, teachers gain access to a highly intuitive visual authoring environment for the creation of sequential learning activities. LAMS is based on the belief that learning does not arise simply from interacting with content but from interacting with teachers and peers. The creation of content-based, self–paced learning objectives for single learners is now well understood in the field of e-learning. However, the creation of sequential learning activities which involve groups of learners interacting within a structured set of collaborative environments - referred to as ‘learning design’ - is less common; LAMS allows teachers to both create and deliver such sequences. In essence, LAMS provides a practical way to describe multi-learner activity sequences and the tools required to support these. Furthermore, LAMS provides tools that support various activities such as communication, presentation of information, writing and sharing resources, as well as posing and answering questions. Nevertheless, Dalziel (2003) has commented on the absence of tools supporting broader ranges of collaborative tasks. In fact, despite the availability of all the tools mentioned above, sequences of learning activities for the performance of the Jigsaw collaboration method within LAMS for the learning of specific CS concepts have not yet reported.

The said sequence of collaborative activities was implemented using essential tools provided by LAMS (http://wiki.lamsfoundation.org/display/lamsdocs/Home). These tools are demonstrated in its interface and are briefly presented below:

The *Assessment tool* allows sequence authors to create a series of questions with a high degree of flexibility in total weighting

The *Chat Activity* runs a live (synchronous) discussion for learners

The *Chat and Scribe Activity* combines a *Chat* Activity with a *Scribe Activity* for collating the chat group's views on questions posed by the teacher

The *Forum Activity* provides an asynchronous discussion environment for learners, with discussion threads initially created by the teacher

The *Forum and Scribe Activity* combines a *Forum* Activity with a *Scribe Activity* for collating Forum Postings into a written report

The *Mindmap activity* allows teachers and learners to create, edit and view mindmaps in the LAMS environment. Mindmaps allow for the organising of concepts and ideas, and exploring how these interact

The *Multiple Choice* activity allows teachers to create simple automated assessment questions, including multiple choice and true/false questions

The *Notebook Activity* is a tool for learners to record their thoughts during a sequence of activities

The *Noticeboard Activity* provides a simple way to supply learners with information and content. The activity can display text, images, links and other HTML content.

The *Question and Answer Activity* allows teachers to pose a question or questions to learners individually, and after they have entered their response, to see the responses of all their peers presented on a single answer screen.

The *Share Resources tool* allows teachers to add content to a sequence, such as URL hyperlinks, zipped websites, individual files and even complete learning objects.

The *Submit Files Activity* allows learners to submit one or more files to the LAMS server for review by a teacher.

The *Survey Tool* presents learners with a number of questions and collects their responses. However, unlike Multiple Choice, there are no right or wrong answers.

The *Wiki Tool* allows authors to create content pages that can link to each other and, optionally, allow learners to make collaborative edits to the content provided.

2.2 The Jigsaw Collaborative Method

The *Jigsaw* method was originally proposed by E. Aronson (1971) at the University of Texas and the University of California. Hundreds of schools have Jigsaw-based activities in their classrooms with much success (see http://www.jigsaw.org). Jigsaw has been seen as a method that can support both cooperative learning (Johnson & Johnson, 1992) and collaborative situations (Silverman, 1995). Gallardo (2003) also thought that this method could be well situated within the constructivist framework of learning. In addition, many researchers have proposed the implementation of this method within the online context (Gallardo et al. 2003; Hernandez-leo et all; Kordaki, Siempos and Daradoumis, 2009), despite the fact that Jigsaw was originally proposed for face-to-face education (Aronson & Patnoe, 1997). Specifically, the *Jigsaw* method is a cooperative/collaborative learning strategy which enhances the process of listening, commitment to the team, interdependence and team work. Each member of the team has to excel in a well-defined subpart of the educational material, undertaking the role of expert. The experts form a different group to discuss the nuances of the subject and later return to their teams to teach their colleagues. The ideal size of teams is 4 to 6 members. Specifically, the implementation of the Jigsaw method could be realized through the following *process*: 1) Divide the problem into sub-problems, 5) Create heterogeneous groups, 3) Assign roles and material to each student, 4) Form group of experts, 5) Let experts study the material and plan how to teach their colleagues, 6) Let experts teach in their groups, 7) Assess students.

Through Jigsaw, the following goals could be achieved: 1) Building of interpersonal and interactive skills, 2) Ensuring that learning revolves around interaction with peers, 3) Holding students accountable among their peers, 4) Encouraging active student participation in the learning process.

In the next section of this paper, the set of collaborative learning activities for the learning of the aforementioned essential issues in CS using the Jigsaw-within-LAMS design pattern is reported.

3 DESIGN OF THE JIGSAW ACTIVITY WITHIN THE CS ONLINE CLASSROOM

The proposed Jigsaw online learning activity consisted of the following seven phases: 1) Introduction to the activity, 2) Original group creation, 3) Creation of expert groups, 4) Back to the original groups, 5) Group Report formation, 6) Group Report presentation and 7) Assessment. The implementation of these phases within the context of LAMS is diagrammatically represented - as a 'design pattern' - in Figure 1. The presentation of this collaborative pattern aims at supporting a combination of synchronous and asynchronous collaboration but this pattern could be used exclusively for asynchronous collaboration by substituting the "Chat and Scribe" function with the "Forum and Scribe" function or vice versa to support exclusively synchronous collaboration. The description of the aforementioned phases is reported in the following section.

Phase 1. Jigsaw: *Introduction to the Activity*

The main goal of this learning activity is to encourage students to learn through performing specific investigations of the following essential issues in CS: (a) the wide range of computer technology used in daily life and the consequences of such utilization, (b) the variety of computer systems serving different tasks, (c) the dynamic evolution of information technology in our times. Additionally, this learning activity aims to highlight the value of collaborative learning as a modern method of teaching.

In the context of these learning aims, students have to investigate essential issues in computer technology such as; the diversity of existing hardware and software, the kinds of computer networks available, the Internet, the social impact of computers as well as their impact on commerce and businesses. To perform these investigations, students should be separated into expert groups according to the aforementioned issues. To this end, the following expert groups need to be formed: (a) the *Hardware* Jigsaw Group (b) the *Software* Jigsaw Group (c) the *Network* Jigsaw Group (d) the *Internet* Jigsaw Group (e) the *Social aspects* of Computer Technology Jigsaw Group and (f) the *Business and Technology* Jigsaw Group.

To perform the aforementioned investigations successfully, each of the aforementioned groups have to collect data from various and significant areas of life where computers are used, namely; (a) financial organizations, such as accounting departments and banks, (b) health caring organizations, such as hospitals, (c) entertainment areas, e.g. Internet cafés, and local TV and radio stations, (d) education, such as schools and public libraries, (e) commercial areas, for example a supermarket or a car garage, and (f) welfare organizations. In this phase of the Jigsaw activity, students are informed - using a Notice board - about the whole context of the activity, including its aims, the specific issues of computer technology that have to be explored during this activity as well as the various places where they could collect appropriate data to fulfil these learning aims. Students should exchange ideas and clarify the aims and the whole procedure of the activity using a whole-class Forum or a whole class Chat-room.

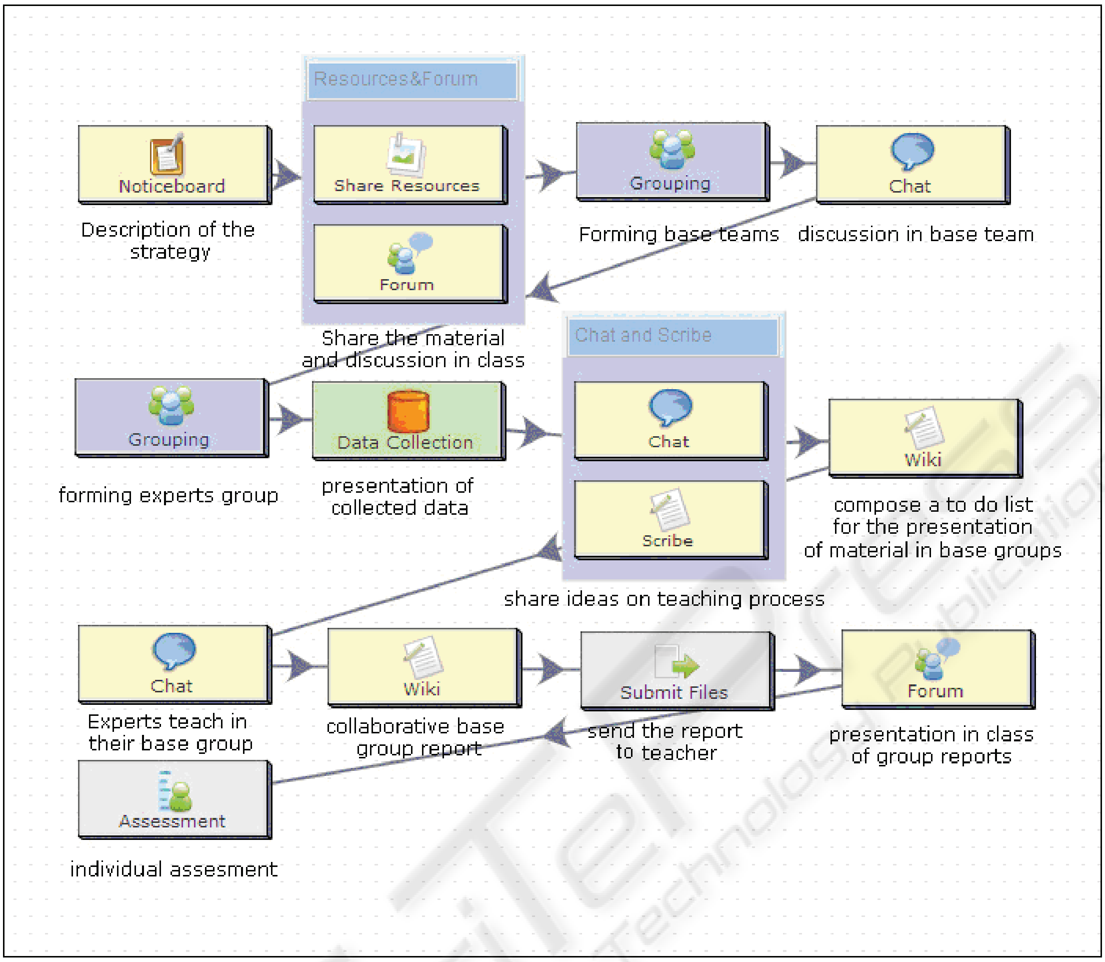

Figure 1: A diagrammatic representation of the Jigsaw method implemented within LAMS.

Phase 2. Jigsaw: *Original Group Creation*

The students are assigned randomly – using the Grouping tool - to 4 groups of 6 students. Initially each group discusses – using a group chat-room or a group forum - the issues presented in the introduction, striving to form a commonly acceptable framework of ideas. Each member of each group should also decide which essential issue of computer technology - from the aforementioned issues – they prefer to investigate.

Phase 3. Jigsaw: *Creation of Expert Groups*

Next, every member of each group would gain expertise on a specific issue of the proposed learning activity through their participation in specific expert-groups. Each expert group must visit the specific areas of life mentioned in the 'Introduction' of the activity where computers are used, to collect specific data. In fact, each expert group has to fulfil a well-defined task, as described in the next section.

Hardware Jigsaw Group. The experts in this group should note the number and type of computers (mainframes, servers, personal computers, PLC). They also have to categorize computer systems according to their technical specifications; power supply requirements and system restore capabilities. Special care must be taken over the recording of the peripheral devices and the degree of diffusion of computer technology use in the modern working environment

Software Jigsaw Group. The experts in this group should identify the operating and application software being used. In particular, they can focus on special purpose software and research, if custom tailored software is used, or commercial solutions. They can also study the use of system security software such as antivirus programs and firewalls. Finally, they should mention the use of backup and data integrity software.

Network Jigsaw Group. The experts in this group could categorize the networks according to their topology (LAN, WAN, etc.), the number of computers in the facilities, the chosen protocols and the efficiency of network operation.

Internet Jigsaw Group. The experts in this group should cope with issues such as possible reasons for using the Internet, the available internet connection bandwidth and its credibility.

Social Aspects of Computer Technology Jigsaw Group. The experts in this group should interview the employees, asking them questions about their level of education, the evolution of their job after the introduction of computers to the working environment, the possible health concerns due to long-term use of computers as well as the effectcomputers and technology have had on their interpersonal relationships.

Business and Technology Jigsaw Group. The experts in this group should talk with Information Technology professionals about the reason behind the adoption of computer technology, the possible gains in efficiency and productivity and the transformations needed to the organization chart due to the use of information technology. They should also discuss the maintenance and the upgrading of technological equipment.

The data collected by each expert group should also be categorized using specific criteria and questions they themselves have formed and those suggested by their teacher. Here, the use of the 'Data collection" tool will be useful. To this end, appropriate learning materials can be used for further understanding of the experimental activity of each expert group.

Besides data collection and processing, the expert groups have to organize an interesting and efficient teaching process to present to their base groups. Sharing ideas about the appropriate teaching process could be implemented through a chat-room or forum for each expert group. There follows a template of possible actions that can be followed by the expert group students:

1. They should try to comprehend as much as possible the deeper meaning of the data they have collected and the materials they have studied. If necessary, they could ask their teacher for help.

2. It is important to emphasize the value of commenting on the key ideas of each specific issue at hand.

3. They should research alternative and interesting learning scenarios in order to provide a pleasant teaching experience for their colleagues. To this end, the teaching process can comprise a variety of learning representations: e.g., photographs, videos, simulations, charts. The experts should not forget the importance of stimulating their colleagues' interest and motivating them to participate in a constructive thinking process, the result of cultivating discussion with the other students.

4. Using a wiki, they should provide their colleagues in their original groups with appropriate presentations and activities that help them to absorb and better comprehend the knowledge offered.

5. Using a wiki, they have to concentrate on the knowledge acquired during their experimentation to design a representative questionnaire reflecting the critical and not the memorizing ability of learners.

Phase 4. Jigsaw: ***Back to the Original Group***

Each expert, on returning to the original group, should propose alternative ways to present the knowledge she/he acquired during her/his participation in the experimentation performed within a specific expert group. Here, the members of the original groups could be provided with some essential activities, so that every student can participate actively in the learning experience. Each expert should also encourage her/his colleagues to better comprehend the knowledge provided. Chat-rooms or forums could be used by each expert to teach their original groups.

Phase 5. Jigsaw: ***Group Report Formation***

Each group has to prepare a presentation about the total knowledge acquired during their learning process. To form this report, the use of a wiki will be useful. The use of the 'Submit Files' activity could be used to sent the reports to the teachers

Phase 6. Jigsaw: ***Group Report Presentation***

Here, it would be useful to provide students with some recommendations as to how to prepare and deliver a good presentation. Some useful guidelines for the former are: (a) The presentation must begin with the main idea of the subject, (b) only the key points of the subject have to be presented, (c) On every slide, only 4-5 key points should be presented, (d) A uniform style of presentation must be followed (unnecessary effects must be avoided since these distract the learner from the key concepts), (e) The duration of each presentation should be around 10 minutes (for synchronous presentation using a chat-room) since there is always the danger the students may get bored. There will be additional time to further discuss the learning material.

Some essential guidelines that can be given to students about their actual online presentation are: (a) Students have to be careful not to overstep the time limit given, (b) The presentation slides are a reference for further development of the subject and not a paper for reading, (c) It is advisable to prepare the presentation in front of their group, in order to evaluate the time needed and obtain experience in speaking in public, (d) It is very important to keep a steady pace in presentation. The audience is not so well informed as they are. (e) It is better to give less information well-presented than large amounts that are incomprehensible.

Online presentations could be performed by each group, using a whole-class chat or forum. During the online presentation, the teacher can initiate a 'question and answer' session to encourage experts to present their area of study in greater detail.

Phase 7. Jigsaw: ***Assessment***

Each student should be set a quiz after the end of the learning activity, for purposes of assessment. The students cannot help each other during the testing process.

4 SUMMARY AND FUTURE PLANS

This paper presented an online collaborative activity - for secondary level education students - for the learning of essential issues in CS, such as: (a) the wide range of computer technology used in daily life and the consequences of such utilization, (b) the variety of computer systems serving different tasks, (c) the dynamic evolution of information technology in our times. The design of this collaborative learning activity was based on the use of the Jigsaw collaborative method in an innovative way, based on the fact that (a) the tasks assigned to the expert groups consisted of various investigating activities within the real world - where computers are actually used - rather than the study of various online learning materials as is still proposed (b) for the design of the whole collaborative activity, intuitive 'learning design'-based online tools provided by LAMS were used. To investigate the effect of this collaboration activity, specific field research is needed using a real online classroom.

REFERENCES

Aronson, E. (1971). History of the Jigsaw Classroom. Retrived from The Jigsaw Classroom: http://www.jigsaw.org/history.htm

Aronson, E., Blaney, N., Sikes, J., Stephan, G. & Snapp, M. (1978). The JIGSAW classroom. Beverly Hills, CA: Sage Publications.

Aronson, E. & Patnoe, S. (1997). The jigsaw classroom: Building cooperation in the classroom. NY: Longman.

Babiuk, G. (2005). A Full Bag of "Tech Tools" enhances the reflective process in Teacher Education. In C. Crawford et al. (Eds.), Proceedings of Society for Information Technology and Teacher Education International Conference 2005 (pp. 1873-1877). Chesapeake/VA: AACE.

Brufee, K. A., (1999). Collaborative Learning: Higher Education Interdependence, the authority of knowledge. Baltimore MD: The John Hopkins University.

Dalziel, J. (2003). Implementing Learning Design: The Learning Activity Management System (LAMS). In Interact, Integrate, Impact. (pp.593-596). Proceedings ASCILITE 2003, Adelaide, 7-10 December. retrieved January 10, 2009, from http://www.ascilite.org.au/conferences/adelaide03/docs/pdf/593.pdf

Dillenbourg, P. (1999). Introduction: What do you mean by collaborative learning?. In P. Dillenbourg (Ed.), Collaborative learning: Cognitive and computational approaches (pp. 1–19). Oxford: Pergamon.

Gallardo, T., Guerrero, L.A., Collazos, C., Pino, J.A., & Ochoa, S. (2003). Supporting JIGSAW-type Collaborative Learning. System Sciences, (p. 8). Hawaii.

Griffiths, D., & Blat, J. (2005). The role of teachers in editing and authoring Units of Learning using IMS Learning Design. Advanced Technology for Learning, 2 (4), retrieved June 10, 2009, from http://www.actapress.com/ Content_Of_Journal.aspx?JournalID=63.

Harasim, L., Hiltz, S.R., Teles, L., & Turoff, M. (1995). Learning Networks: a field guide to Teaching and Learning Online. Cambridge: MIT Press.

Haythornthwaite, C., Kazmer, M. M., Robins, J., and Shoemaker, S. (2000). Community development among distance learners: temporal and technological dimensions. Journal of Computer-Mediated Communication, 6 (1). Online: http://www.ascusc.org/ jcmc/vol6/ issue1/haythornthwaite.html.

Johnson, D.W. & Johnson, R.T. (1992). Positive interdependence: Key to effective cooperation. In R. Hertz_Lazarowitz & N Miller (Eds.). Interacting in cooperative groups. The theoretical anatomy of group learning (pp. 145-173). New York: Cambridge University Press.

Kalyva, G. and Kordaki M. (2006). Computer Science Teachers' Real Practices: a case study. In Proceedings of International Conference on Information and

Communication Technologies in Education (ICICTE), Rhodes, Greece, July 6-8, 2006; pp.245-251.
Koper, R., & Tattersall, C. (Eds) (2005). Learning Design: A handbook on modeling and delivering networked education and training. Berlin: Springer.
Kordaki, M., Papadakis, S. and Hadzilacos, T. (2007). Providing tools for the development of cognitive skills in the context of Learning Design-based e-learning environments. In T. Bastiaens and S. Carliner (Eds), Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare & Higher Education (E-Learn 2007), October, 15-19, Quebec, Canada, USA, pp.1642-1649, Chesapeake, VA: AACE.
Kordaki, M. and Daradoumis, T. (2009). Critical Thinking as a Framework for Structuring Synchronous and Asynchronous Communication within Learning Design-based E-learning Systems. In T., Daradoumis, S., Caballe, J.M., Marques and F., Xhafa, (Ed.), 'Intelligent Collaborative e-Learning Systems and Applications', Studies in Computational Intelligence. Berlin-Heidelberg: Springer-Verlag, pp. 83-98.
Kordaki, M. and Siempos, H. (2009). Encouraging collaboration within learning design-based open source e-learning systems. In J. Dron, T Bastiaens and C. Xin (Eds) Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare & Higher Education (E-Learn 2007), October, 26-30, Vancouver, Canada, USA, pp. 1716-1723, Chesapeake, VA: AACE.
Kordaki, M., Siempos, H. and Daradoumis, T. (2009; to appear). Collaborative learning design within open source e-learning systems: lessons learned from an empirical study. In G. Magoulas (Eds), E-Infrastructures and Technologies for Lifelong Learning: Next Generation Environments, IDEA-Group Publishing.
Koschmann, T. (1996). CSCL: Theory and practice of an emerging paradigm. Mahwah, NJ: LEA.
LD (2003). IMS Learning Design. Information Model, Best Practice and Implementation Guide, Version 1.0 Final Specification IMS Global Learning Consortium Inc., retrieved June 30, 2009, from http://www.imsglobal.org/learningdesign/.
Lehtinen, E. (2003). Computer-supported collaborative learning: an approach to powerful learning environments. In E. de Corte, L. Verschaffel, N. Entwistle, & J. van Merrieboer (Eds.), Powerful learning environments: Unravelling basic components and dimensions (pp. 35–54). Amsterdam: Pergamon.
Lipponen, L. (2002). Exploring foundations for computer-supported collaborative learning. In Gerry Stahl (Ed.), Computer support for collaborative learning: Foundations for a CSCL community (pp. 72–81). Proceedings of the Computer-supported Collaborative Learning 2002 Conference. Hillsdale/NJ: Erlbaum.
Lloyd, G. & Wilson, M. (2001). Offering Prospective Teachers Tools to Connect Theory and Practice: Hypermedia in Mathematics Teacher Education. Journal of Technology and Teacher Education. 9 (4), 497-518. Norfolk/VA: AACE.
McAndrew, P., Goodyear, P., & Dalziel, J. (2006). Patterns, designs and activities: unifying descriptions of learning structures. International Journal of Learning Technology, 2(2-3), 216 - 242.
Palloff, M.R., & Pratt, K. (2004). Learning together in Community: Collaboration Online. In 20th Annual Conference on Distance Teaching and Learning, August 4-6, 2004, Madison, Wisconsin, Retrieved on Sept. 30, 2009, from http://www.uwex.edu/disted/conference/Resource_library/proceedings/04_1127.pdf
Panitz, T. (1997). Faculty and Student Resistance to Cooperative Learning. Cooperative Learning and College Teaching , 7 (2) Winter, 1997.
Picciano, A.G. (2002). Beyond student perception: Issues of interaction, presence and performance in an online course. Journal of Asynchronous Learning Networks, 6(1), 21-40.
Roberts, T. S. (2005). Computer-supported collaborative learning in higher education: An introduction. In: Roberts, T. S. (ed). Computer-supported collaborative learning in higher education. Idea Group Publishing, Hershey, pp 1–18.
Scardamalia, M., & C. Bereiter, C. (1996). Computer support for knowledge-building communities. In T. Koschmann (ed.) CSCL: Theory and practice of an emerging paradigm, (pp.249–268). Mahwah, NJ: Erlbaum.
Silverman, B.G. (1995). Computer Supported Collaborative Learning (CSCL).Computers Education, Vol. 25 (3), 81-91.
Van Eijl, P. & Pilot, A. (2003). Using a virtual learning environment in collaborative learning: Criteria for success. Educational Technology, 43(2): 54–56.
Diggelen, W.V. & Overdijk, M. (2009). Grounded design: Design patterns as the link between theory and practice. Computers in Human Behavior (2009), doi:10.1016/ j.chb.2009.01.005