# Fostering NCL in higher education: new approaches for integrating Educational Technology Instructional Design into teachers' practice

Draft of:

Alvino S. & Trentin G. (2011). Fostering NCL in higher education: new approaches for integrating Educational Technology Instructional Design into teachers' practice. In A.D. Olofsson & J.O. Lindberg (Eds), *Informed Design of Educational Technologies in Higher Education: Enhanced Learning and Teaching*, ch. 17 (pp. 331-351). IGI Global, Hershey, PA, USA.

Serena ALVINO, Guglielmo TRENTIN
Institute for Educational Technology, National Research Council, Italy

## ABSTRACT

Networked Collaborative Learning (NCL) is undeniably a double-edged sword. On the one hand it can yield high-quality learning and enhance both teachers' and learners' satisfaction. On the other hand, however, it requires careful planning and specific skills for the design and management of online learning activities. This is one of the main reasons for the limited adoption of NCL in a number of educational contexts.

The focus of this chapter is a specific proposal aimed to foster the wide diffusion of Educational Technology (ET) and NCL in higher education (HE).

In this perspective the chapter analyses the main barriers that limit the diffusion of Network-Based Educational Technology (NBET) approaches, in particular NCL, and then, in order to overcome them, presents an innovative approach to faculty training in Educational Technology Instructional Design. This approach is founded on multidimensional scaffolding, which support teachers to integrate rules, heuristics and best practices for design of active and collaborative online learning into their everyday activity.

## 1. INTRODUCTION

Although learning is indeed an "individual" process of growth and transformation of personal knowledge, it is however advisable for it not to remain an "isolated" process, even when it is managed online. Over 20 years ago, in his work entitled "Megatrends", John Naisbitt (1984) claimed that one of the keys to the success of distance learning was the combination of "high-tech" with "high-touch", i.e. of the sophisms of technology with contact between people, in our specific case between educators, course students, experts etc.

Technology itself is seldom the real obstacle to educational innovation centred on Educational Technology (ET). As pointed out by the AECT[1], since *Educational Technology* can be considered as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (Januszewski & Molenda, 2008), it doesn't relate only to technology as a "tool", but also and mainly to theories, methods and practices facilitating learning through specific technology-based resources and processes. In fact, the main problems concerning ET-centred innovation are almost always related to achieving better understanding of the role of the human component within the technology-based processes, and of the potential and limitations of network-mediated interaction in the improvement of distance learning processes (Naisbitt, 1984).

On the one hand, if we analyse the most common uses of Information and Communication Technology (ICT) in higher education, it is not difficult to realise that students often find themselves assuming a passive role within a learning process which is mainly guided by the educational material prepared by the teacher (Collins & Van der Wende, 2002; Kirkwood, 2009). On the other hand, social constructivism (Vygotsky, L.S., 1978; Gunawardena et al., 1995) has brought to light the importance of interaction – among learners and between teachers and learners – in attaining specific learning goals. More generally, it has revealed the impact that these interactions can have on cognitive and metacognitive processes, on the motivation to learn, on self-esteem and on the development of social belonging (Bronfenbrenner, 1979).

Several research studies and experiences (Bruffee, 1999; Collazos, et al., 2004; Kreijns & Kirschner, 2004) have shown that collaborative learning experiences normally enhance the development and the employment of high-level thinking skills (Brown, & Palincsar, 1989). These premises can be easily extended to Networked Collaborative Learning (NCL), whose pedagogical dimension is based on social constructivism (Daradoumis & Marquès, 2000; Felder & Brent, 2001).

In this sense, the term NCL does not merely indicate that the education process is supported by a computer network, but also (and more significantly) that the process is underpinned by, and conducted through, a network of inter-relationships among all the actors of the process: learners, teachers, tutors, experts (Trentin, 2010). These inter-relationships are intrinsic to collaboration within a community pursuing a common learning goal. So the network should be seen primarily as a social network, and not merely as a computer network for distance communication between individuals.

The NCL approach has various important implications (Koschmann, 1996; Fink, 1999).

- *educational implications*: emphasis on "learning by doing", students involvement in a collaborative knowledge building, and a change in teacher's role from "authority and knowledge holder" into "guide and facilitator";
- *a new vision of the "information" concept*: the information itself is inert matter, lacking that dense network of logical and communicative connections which can transform it into significant group knowledge;
- *a new focus of the learning process*: the subject is placed at the centre of the learning process; information must be understood and interpreted before being assimilated, and thus it must be situated, or derived by a process of individual participation in socially-structured practices.

While NCL is certainly not the only option open to a teacher looking to adopt ICT in HE (Adam & Warren, 2008), it nonetheless offers enormous potential for innovating teaching approaches (Daradoumis & Marquès, 2000). One way it does this is by leveraging the technologies and forms of communication that students are now accustomed to using in their daily lives (Culligan, 2003).

However, it calls for careful planning, and can only be introduced with suitable preparation and training, especially in the design and management of online learning activities.

This takes us to the wider issue of professional development for academic staff, something that plays a critical role in the pedagogical sustainability of NCL (Seufert & Euler, 2003; Attwell, 2005; Briggs, 2005; Trentin, 2010). The role of the *e-teacher* cannot be improvised; it should form an integral part of the teacher's overall professional growth. This does not simply mean acquiring sufficient know-how to introduce technology in support of habitual teaching practices

(Kirkwood, 2009). Rather, it means totally rethinking and revising those practices (Felder & Brent, 2001; Bates, 2003). This is probably the reason why approaches focusing on NCL are less commonly applied (Zemsky & Massy, 2004).

In this sense, the focus of this chapter is, on the one hand to understand the causes that limit the diffusion of NCL approaches in higher education and, on the other hand, to propose possible solutions to foster a wider use of the same approaches. Consequently the main objectives of this chapter are:

- to analyse the stages through which university teachers progressively master Network-Based Educational Technology (NBET), i.e. the specific area of ET which focuses on the educational use of network technology;
- to identify the main causes of the poor exploitation of NCL potentialities in higher education
- to describe new approaches to Educational Technologies Instructional Design which are able to improve and enhance teachers' skills in designing effective NCL activities and courses.

## 2. BACKGROUND

The examination of processes that have characterised the progressive approach of faculty teachers to ICT instructional use, highlights at least four recurrent stages (Zemsky & Massy, 2004; Trentin, 2008):

*Enhancements to traditional course configurations* – It envisages the use, within a traditional learning/teaching process, of fresh types of materials (in digital format) made available by the teacher on the faculty's website or found directly by the student on the Internet. The approach therefore introduces no significant changes to the traditional teaching method (Creighton & Buchanan, 2001; Sauter, 2003).

*Use of new course management tools* – It envisages the use of specific software systems (LMS[2], CMS[3], etc.) to facilitate both teacher/student interaction from a distance (one-to-one or group) and more effective, structured organisation and distribution of teaching material (Attwell, 2007).

*Use of learning objects* – In this stage, the objective is to make the learning activities as rich and motivating as possible using traditional tools for the development of educational materials (Longmire, 2000; Shamsuar, 2008). For example, there are multimedia materials, tele-lessons by video streaming, interactive simulations etc.

*New course configurations* – Of the four stages, this is clearly the one which, more than the others, aims to make substantial changes to the way of teaching with the support of ICT. Teachers are therefore required to reassess their teaching methods and to reap the maximum benefit from the use of new technologies and help facilitate their students' learning process. This process is based on active learning (Fink,1999; Briggs, 2005) and the combination of diverse modes of interaction among students, teachers, tutors etc., carried out either face-to-face or from a distance, synchronous or asynchronous (Salomon, 2002; 2004). Clearly this is not irrespective of the availability of both teachers and students to assume a different way of behaving reciprocally from what happens in a normal classroom situation.

As can be imagined, the four stages correspond to different time phases for their respective introduction.

The *Enhancements to traditional course configurations* is definitely the fastest development stage and lies in the initial phases of the innovation process. Also the stage introducing the *Course Management Systems* evolves fairly rapidly, but not so much in terms of the number of teachers adopting NBET than in terms of the student-teacher ratio involved in courses and programmes employing course management software.

These two initial stages generally complement and reinforce each other reciprocally (Zemsky & Massy, 2004). However, neither of them is based on the introduction of *learning objects* nor on the development of *new course configurations*. On the whole, they introduce a limited adoption of ICT mainly based on: (a) the use of digital resources to present contents (e.g. PowerPoint), (b) the almost unconditioned adoption of the teaching-style underpinning CMS, (c) the use of

automated tests and, (d) sporadically, the organization of theme forum discussions related to the course content. At best, they also envisage importing and using simple learning objects.

*New courses configurations* are rarely developed and often don't exploit the wide possibilities offered by new educational technologies to promote user-centred, personalized and flexible learning processes (Klobas & Renzi, 2003; Elliot, 2008).

This trend reflects the various ways network-based Educational Technology is used in higher education (Howell et al., 2004). In particular, the taxonomy of Figure 1 presents an overview[4], where the various NBET approaches have been grouped into six macro-categories (Trentin, 2006; 2008) and arranged according to the level of complexity.

Fig. 1 – A possible taxonomy of the main NBET approaches in higher education (Trentin, 2008)

*Informative use* – this is the simplest and most immediate way to use the Web, based on the network channel for sending information to students (information about the course, dates of exams, office hours etc.)

*Distributive use* – according to this approach the Web is considered as a one-directional channel for supplying students with any digital material which can be electronically delivered: slides used in the lessons, handouts, articles and book chapters, exercises, texts of previous exams, self-assessment tests, etc.; generally however materials not specially designed for distance learning activities (hence not planned and developed *ad hoc*).

*Interactive use* – this is the way of using the Web which fosters the various forms of personal interaction:

- "one-to-one" teacher/student, used for requests for information, questions and answers about specific topics of the course, for providing individual corrections of assignments etc.

- "one-to-many", typical of the tele-lessons delivered in synchronous mode with the possibility of dialoguing with the teacher using synchronous and/or asynchronous return channels;
- "many-to-may", almost always based on asynchronous interactions using forums, computer conferencing systems, e-groups etc. to conduct collaborative types of activity, one- to two-week workshops etc.

*Blended solutions* – solutions which use an alternation of classroom and distance activities, where the latter are not optional, but are an integral part of the course (Davies & Fill, 2007; MacDonald, 2008). This type of approach is often used to reduce the number of face-to-face lessons in order, for example, to help working students or those living far from the university site.

*Content-driven e-learning* – This approach envisages web-based courses (or parts of them) mostly based on pedagogically-structured educational resources. In this case it is not therefore a question of putting onto the web materials which are already available to the teacher in various forms (see *distributive use*), but of developing specific materials, designing and creating them according to Distance Education methodologies (Garrison, 2003): thus, teaching materials which, besides being vehicles of disciplinary content, are also able to offer the student a didactic guide to their use, with exercise and self-assessment environments and learning itineraries which are customised to suit the users' varying needs, etc.

*Networked Collaborative Learning (NCL)* – NCL approaches fall under the wider paradigm of Computer-Supported Collaborative Learning (CSCL), i.e. "an emerging branch of the learning sciences concerned with studying how people can learn together with the help of computers" (Stahl et al., 2006, p.1). CSCL is founded on collaborative learning, as mutual engagement of participants in a coordinated effort to pursue a specific learning goal (Stahl et al., 2006). In other words, while educational resources play a key role in "content-driven" learning to guide the students towards the declared educational goal, NCL educational processes are directly managed by the teacher and are based on the integration between individual and collaborative study (Daradoumis & Marquès, 2000; Trentin, 2010).

NCL can be considered as a specific approach to NBET, which requires the presence of various general conditions in order to be effectively applied; among them we can identify (Felder & Brent, 2001; Palloff & Pratt, 2005):

- the teacher's willingness to redesign the course, making even quite considerable modifications to the version conceived for face-to-face teaching (Paulson, 2002);
- the specific ability of teachers (or tutors) to design learning activities based on online interaction and to organise and manage online learning groups (Klobas et al., 2008);
- the pertinence of the collaborative strategy to the declared educational goals;
- classes with low numbers of students;
- the availability of adequate network services supporting group communication, distance interactions among all participants (students, teachers, tutors, etc.), and structuring of a virtual space, in terms of areas, actors and relative rules;
- students who are able to access frequently the virtual space.

The lack of these essential conditions is often the main cause of the restricted use of NCL in higher education.

At the same time, this low diffusion constitutes a sort of paradox, since the social dimension is a key element in higher education, where there is a strong need for direct teacher/learner contact and where the teachers should adopt a variety of strategies, especially interactive ones, to support learning.

## 3. A FOCUS ON HOW TO INTEGRATE NBET IN UNIVERSITY TEACHERS' PRACTICE

One of the most critical aspects linked to the diffusion of NCL approaches is teachers' acquisition of at least the basic skills of Educational Technology Instructional Design, i.e. knowledge and awareness of the main theories, principles and best practices to design learning processes based on specific educational models and strategies (deriving from the main learning theories) and enhanced by the integration of specific technologies, such as ICT.

In fact, university teachers are essentially experts in a given disciplinary/content domain and they often lack pedagogical skills and know-how. What can be realistically asked of them is to (Young, 2002; Zeminsky & Massy, 2004):

1. make available their knowledge on a specific content domain, together with the methods to teach them;
2. invest a reasonable amount of time in acquiring elementary instructional design skills;
3. acquire familiarity with the typical dynamics of an educational process based on online interaction, and with the methods for conducting it.

In this perspective, a number of faculty training initiatives have been undertaken over the years (Grant, 2004; De Vries et al., 1995) aimed at the sharing of methodological and technological best practices for Educational Technology Instructional Design and targeting those teachers who are interested in innovating their teaching, with particular attention to the social dimension of learning.

Some successful experiences (Trentin, 2006; Klobas et al, 2008; Palloff & Pratt, 2010) have demonstrated that, in order to guarantee a high follow-up rate for faculty training processes, the training stage must be organized around project/problem-based strategies, with one-to-one assistance of the teachers in their first experience of planning online teaching activities. This assistance is fundamental when adopting NCL approaches, since they require constant adaptation of the learning path to the ongoing interaction and collaboration processes.

However, if on the one hand "personalised" faculty training guarantees high follow-up rates, on the other hand it introduces costs which can be afforded only with the support of regional, national or international funding; this is the reason why these initiatives are rarely set up (Trentin, 2006).

The problem is thus how to diffuse NCL best practices at affordable costs, while assuring constant support to the teachers who try to integrate these practices in their courses.

In the following sections, this chapter will present an innovative approach to Educational Technology Instructional Design teacher training, based on a multidimensional scaffolding which fosters teachers to integrate the rules, heuristics and best practices for easily and effectively designing active and collaborative online learning in their everyday activity.

## 4. AN INNOVATIVE APPROACH TO TEACHER TRAINING IN EDUCATIONAL TECHNOLOGY INSTRUCTIONAL DESIGN

Over the last twenty years, a number of Instructional Design (ID) models have been proposed and adopted to formalise the design process. ID is defined by Reigeluth *et al*. (2003) as "that branch of knowledge concerned with theory and practice related to instructional strategies and systematic procedures for developing and implementing those strategies" (p.574). Since educational scenarios are often poorly structured and influenced by a number of variables, the main assumption behind ID principles and procedures is that there is no generally effective formula to be applied every time and everywhere, but that the best options must be chosen each time for specific contexts and situations and for particular learning objectives and contents. Thus, the role of models in ID is to provide teachers and designers with conceptual tools fostering the modelling, structuring and management of a learning process. ID models may support the sharing of best practices and thus the training of novices; they also allow meta-analysis and evaluation of the design process itself.

Recently, several authors (Jonassen, 2008; Silber, 2007) have criticised the conventional linear and procedural ID models (Clark, 1995), as well as other recursive and spiral-based models (Tripp & Bichelmeyer, 1990), arguing that ID as practised by expert designers is not a procedure, but a problem-solving process. To tackle design problems experts refer to a mental "template" which is able to capture both declarative knowledge and context-related heuristics (Foshay et al., 2003).

Other critics argue that ID is an iterative process of decision-making and model-building (Jonassen, 2008). The principal role of a designer is to make decisions which help bridge the gap between ideas and reality. These decisions are taken all along the ID process, which proceeds through a progressive contextualization and introduction of constraints, guided by those heuristics and good practices which are held to be effective for a particular problematic situation (Alvino et al., 2009).

According to these premises, one of the first steps for fostering the integration of Educational Technology (especially NBET) ID into teachers' practice should be the sharing and interiorization of heuristics and good practices. Normally teachers develop a meaningful tacit knowledge based on mental schemata that are progressively enriched by everyday experience. Unfortunately, there is not a widespread inclination to make this knowledge explicit and share it,

especially in the field of Computer Supported Collaborative Learning (CSCL), and particularly in Networked Collaborative Learning (NCL), where computer-mediated interactions among learners are promoted as a key factor for improving learning, but where good practices in how to structure these interactions have so far been little shared by experts (Koschmann, 1996). But if no generally effective formula is given, novices and unskilled teachers should be able to refer to models and resources which can guide or scaffold them during the design process. In view of this, recent national and international initiatives aimed at promoting the sharing of models of expert designers' heuristics and best practices, as well as learning materials, take on a key role for both informal learning experiences and formal teacher training.

### 4.1 The sharing of reusable learning resources and models

In last few years, a number of studies and initiatives have been carried out to support the modelling, formalisation and sharing of ID good practices.

In particular, a number of models and standards have been studied and proposed for the devising of a common semantic and technical way of sharing learning materials (Wiley, 2001; ADL, 2004), and for the making explicit and formalising of design models (Dillenbourg & Hong , 2008).

Current trends in the e-learning field show the benefits arising from investment in the creation, sharing and reuse of *Learning Objects* (LOs), i.e. "any digital resource that can be reused to support learning" (Wiley, 2001, p.7). According to Wiley's general definition, LOs are digital resources which can be generated with purposes which may be either educational (such as tutorials, self-learning units and modules, but also case studies, webquests, simulations, etc.) or not (such as scientific papers, digital book chapters, glossaries, FAQ lists, etc), and which a teacher can use to enrich and integrate the learning process he/she is designing. Thus, LOs are a specific educational technology which (more or less explicitly) embodies ID strategies (transmissive, active, collaborative, etc.) and techniques (tutorial, multimedia fruition, problem-solving, simulation, etc) (Wiley, 2001), which can be applied to a specific educational context, normally with a small effort of adaptation. So, LOs can be considered precious "items in the teacher's toolbox" which can be used to enrich a module or a course, taking advantage of the experience of other teachers.

But teachers often do not need to search for new learning materials; they rather need for a scaffold when structuring a learning experience integrating Educational Technologies and NBET in particular. So they often search for models which can be adapted and contextualized to their own scenarios, especially in NCL settings, since varying the approaches to structuring students' interactions and to group composition can be very important for successful collaborative learning.

An important bridge has recently been created between collaborative learning and traditional ID methods with *Computer Supported Collaborative Learning scripts* (Dillenbourg & Hong, 2008). CSCL scripts computationally specify, sequence, and distribute the roles and activities involved in a computer-supported collaborative learning situation, thus providing a certain degree of scaffolding for fostering learners' engagement in potentially more effective interactions (Weinberger et al., 2008). Successful collaborative learning normally depends upon effective interaction amongst learners. When they are left to their own devices, they rarely engage in productive interactions. Collaboration scripts aim to foster collaborative learning by shaping the way in which learners interact with one another. These models specify a sequence of learning activities and learners' roles, based on the use of NBET, thus triggering engagement in social and cognitive activities that would otherwise occur rarely or not at all (Kobbe *et al*, 2007).

Recently a distinction has been introduced between *micro-scripts* and *macro-scripts* (Dillenbourg & Hong , 2008, p.7):

- *Micro-scripts* are "dialogue models, mostly argumentation models, which are embedded in the environment and which students are expected to adopt and progressively internalize".
- *Macro-scripts* are "pedagogical models, i.e. they model a sequence of activities to be performed by groups".

The main difference between them is in the granularity (dimension) of the prescribed actions. For instance a micro-script may automatically prompt a student to respond to post, while a macro-script may model a brainstorming activity in a group.

Macro-scripts can also assume three main levels of abstraction: (a) the s*chema level*, which is the most abstract one, presents the solution to a general recurrent educational problem; (b) the *instance level* presents a particular instantiation of the general problem, characterised by specific contents, roles, tools, services and particular target users; (c) the *session level* is the formalized representation of a concrete educational session (Dillenbourg & Hong , 2008).

In this framework, we can place models such as (Alvino, 2008):

- *pedagogical design patterns*, i.e. design-oriented schemas, which embed particular strategies or techniques in order to make good practices transferable; they are not instantiated in a particular knowledge domain or oriented to specific targets, but provide solutions to typical educational problems; although formulated in plain language, they observe particular structural templates, thus they can be considered as a particular type of schema-level macro-scripts;
- *lesson plans*, which represent in plain natural language the instantiation of the solution to a general educational problem in a specific knowledge domain and for a specific target, in terms of objectives, strategies, resources, and so on; these models can be considered as a particular type of instance-level macro-scripts;
- *EML Units of Learning*, which model the flow and structure of modules or entire courses by using formal languages (EML – Educational Modelling Languages; for instance the IMS-LD specification (IMS, 2003)), on the basis of their embedded methods, proposed activities, the roles involved, services and resources; like *lesson plans*, these models can be considered as a particular type of instance-level macro-scripts, but they differ from the former in being automatically interpretable by computers.

Macro-scripts in particular have shown a very interesting potential in providing a scaffold for teachers designing collaborative learning experiences based on NBET. Several types of research initiatives have tackled this challenge by investigating: the identification of templates for devising a common way of formalising and sharing these resources (e.g. *Pedagogical Pattern Project, TELL project*); the creation of communities in which CSCL scripts are shared and exchanged; the definition of CSCL script design processes based on the reuse of patterns, exemplars, and other script components (Alvino et al, 2009); and the development of CSCL script authoring tools based on practitioner-friendly abstractions and graphic representations (Hernández-Leo et al, 2006).

Both LOs and CSCL scripts could provide teachers with a fundamental scaffold. Despite this, very few teachers are aware of the potential of reusing LOs and scripts, and many of them do not know how to search, find and integrate these resources into their learning initiatives.

In order to tackle this problem, a first fundamental step is *to support the sharing of LOs and design models in open and free repositories*. In this perspective, a number of national and

international initiatives have been carried out to set up repositories of LOs (such as *Merlot*, *Ariadne Knowledge Pool*, the *GEM Catalog*, etc.), pedagogical design patterns (such as *The Pedagogical Pattern Project*), lesson plans (such as *Curriki*, *EDSITEment*, *Education World*)[5], and other scripts.

Accessing these systems teachers can concretely identify LO which fit their needs and reuse them by downloading a file or simply annotating their location (URL). Subscribing to the communities underpinning these repositories, teachers can also share the resources they authored, although filtered by an evaluation process of their quality.

Furthermore, local initiatives supporting the sharing of educational resources and design models are more and more widespread; local, targeted and customized repositories are normally developed to fulfil the specific needs of determinate educational institutions, such as Universities or training centres, or specific professionals, or particular content domains and topics. Like the international initiatives, normally the repository is underpinned by a community, which can be both virtual and presencial.

In any case, sharing educational materials is not a straightforward task for teachers, but requires them to invest their time in searching for resources which fit their needs, and to prepare new contributions in easily re-usable and adaptable form. *Teachers' motivation to share and reuse LOs and CSCL scripts should be fostered* though easy-to-use systems which allow retrieval of high-quality and effective resources. An early example in this direction is the *Merlot project repository*, which promotes teachers' confidence in availing themselves of the repository by offering a quality guarantee, at least to a certain extent, for the LOs that can be retrieved; it also adds value to these LOs by including user comments and proposals for assignments. In this way, repositories of educational resources for TEL could turn into a basis for the formation of teachers' learning communities.

The possibility to express and formulate their actual needs through the retrieval system, so as to find the most adequate resources for each situation, is a fundamental condition to motivate teachers to share and reuse digital educational resources. Unfortunately, most of the international metadata standards used to describe LOs (see for example *Dublin Core Metadata Element Set Version* 1.1 (DCMI, 2003) or the *Learning Object Metadata* standard (IEEE, 2002)) are unable to give a clear pedagogical picture of them or to describe design models adequately. In addition, it is a hard challenge to devise metadata models which can be successfully employed by a wide

variety of user communities, as these are usually characterised by different languages, backgrounds, motivations and objectives. To overcome this limitation, recent studies analyse the problem from the perspective of educational practice, proposing metadata application profiles which include pedagogical descriptors which are able to describe NBET dimensions and which can be selected according to the orientation and the objectives of specific user communities (e.g., GEM http://thegateway.org/, EDNA - http://www.edna.edu.au/). The POEM (*Pedagogy Oriented Educational Metadata*) model, for instance, has been progressively moulded on the needs of a variety of teachers' communities involved in its validation process; it aims to capture the main educational characteristics of both LOs and scripts, such as CSCL macro-scripts, including learning strategies, suggested activities, contextual information, etc.(Alvino et al., 2008).

### 4.2. A multidimensional scaffolding supporting teachers to build a personal ID mental model

Providing novices and unskilled teachers with examples of best practices and reusable learning materials is a fundamental step towards enriching their expertise. Unfortunately, this step is often not sufficient to foster the integration of these heuristics into everyday practice. In fact, teachers often do not know for instance how to integrate LOs and scripts into the learning experiences they are designing. Whereas expert designers tackle educational design problems on the basis of a well-known and shared set of principles and heuristics that form their mental model (Silber, 2007), novices or unskilled teachers who have not yet developed the same mental structure cannot act likewise, unless supported by a scaffold. Thus, initially they need to refer to a simplified and structured model in order to approach the design problem.

Teacher training in the field of ID should take these premises into account. *Teachers should be fostered to build a personal ID mental model* by providing them with *a scaffolding that progressively fades out* once the mental model is more structured. This should be a "multidimensional" scaffolding characterized by:

- *basic general ID models*, which provide a clear structure for the main steps and decisions of an ID process, especially in the field of NCL;

- *reusable educational resources and models*, such as LOs and CSCL scripts, that teachers can retrieve on the Web and reuse to design individual or collaborative activities or entire courses;
- *heuristics and best practices* concerning (a) how to progressively introduce recursivity into the basic general ID models and (b) how to integrate reusable resources into an ID process (especially if based on NBET)

According to this approach, teachers should primarily build their own ID mental model on *a clear structure of the main steps of an ID process*. To this end, traditional models such as ADDIE[6] (Clark, 1995) turn out to be very useful, since they can be considered as phase models of problem-solving, which try to represent what an expert designer knows schematically, procedurally, and in an outlined form (Jonassen, 2008). Although we could identify at least 13 versions of the ADDIE model, each of them is characterized by a "cascade" sequence of design steps and by the fact that the output of each design phase is the input of the following one. Using these models as a reference in ID teacher training could help to clearly outline the main elements, constraints and decisions which characterize each phase and which are necessary to develop the subsequent steps. In particular, when designing a NBET-based NCL experience, it is fundamental to identify and take into account some initial constraints, such as (Alvino et al, 2009): (a) economic and financial constraints, (b) user-profiling constraints, (c) context-related constraints, and (d) technological constraints. In addition, the teacher or the designer has to take some decisions on a number of fundamental topics, such as (Alvino, 2009; Trentin, 2001):

- definition of the aims of the learning process and structuring of the learning objectives;
- definition and structuring of the learning content;
- definition of the learning strategies and techniques (and possible reuse of schema-level CSCL scripts, such as pedagogical design patterns);
- definition of the learning activities (and possible reuse of instance-level CSCL scripts, such as lesson plans) and of the learning groups (in terms of number, dimension and composition).
- definition of the required learning resources: identification of already-available resources, development of new ones, reuse of LOs retrieved on the Web;
- definition of monitoring and evaluation aims, criteria and indicators;
- definition of course schedule and other detailed design elements;
- identification of the communication needs and of the interaction channels and rules;

- definition and structuring of tools and areas characterizing the Learning Management System (LMS) (or other systems and tools supporting the networked learning process).

When an expert designer tackles ID as a problem-solving process, he/she normally does not analyse these topics exactly in this order; firstly he/she focuses on some decisions and then refines the design through an iterative and recursive process. This can be done because expert designers are well aware of the reciprocal conditioning of the different design elements. Thus the "cascade" structure could provide a first fundamental scaffold for novices, since it acts as an "ordinate checklist" which reminds them of the fundamental steps they should not neglect.

Once this basic structure has been embedded in unskilled teachers' mental ID model, they could be provided with *heuristics and best practices about how to introduce recursivity into the linear-cascade model*, progressively approaching a problem-solving perspective.

A first step could be to identify a *two-layered design process* characterized by a *macro-design phase* and a *micro-design phase* (Trentin, 2001). The linear-cascade model is split into two main partially-overlapping ID phases (see Fig. 2). In the "macro" phase, aims, objectives, contents, learning strategies and evaluation criteria are generally defined and outlined. In the following "micro" phase there is an iterative process of revision and/or integration of what has been defined in the macro-design; each decisional topic being reviewed and defined in greater detail; subsequently, learning techniques, activities, groups and resources are defined, together with the characteristics of the monitoring process, the schedule, etc. Parallel to the two-layered process, interaction and communication issues are tackled and technological decisions taken.

This model has revealed its effectiveness in a number of faculty courses and teacher training curricula (Trentin, 2006; Klobas et al., 2008).

Fig. 2 – A comparison of three ID models: the ADDIE model, the two-layered design model and the *Recursive Constraints Analysis* model

Once they are skilled in managing this two-layered ID process, teachers could try to carry out more iterative processes of revision. To this end, they should be provided with *further rules and heuristics to effectively manage the constraints which characterize the ID of a NCL process based on NBET.*

In fact, in a NCL process we can identify three main types of constraint (Alvino et al., 2009): 1) *initial*, i.e. technical, financial and contextual constraints characterizing the specific learning context; 2) *structural*, i.e. constraints deriving from choices and decisions taken during the design process which condition posterior choices (i.e. objectives, contents, etc.); 3) *heuristic*, i.e. constraints related to the application of the heuristics and good practices for effectively structuring the learning community, organizing collaborative activities and modelling the learning environment. According to the *Recursive Constraints Analysis model* (Alvino, 2008), each decision taken during the ID process and concerning the above mentioned topics: (a) should take into account the initial, structural and heuristic constraints introduced before that step and (b) might introduce new structural and heuristic constraints which will condition subsequent choices. If previous structural and heuristic constraints conflict with the new decisions, some changes could be introduced into the design without modifying the general framework. In this way, to obtain a coherent instructional design, *teachers need to assume a permanent attitude of iterative review* (see Fig. 2). *These rules are especially true when teachers want to integrate LOs and CSCL scripts into the ID process.* In fact, these resources are normally characterized by structural and heuristic constraints which have to be taken into account when integrating them into a specific ID process. As stressed before, LOs and CSCL scripts can be integrated at different steps of the ID process, when defining learning strategies, techniques, activities and materials. For instance teachers should be aware that specific collaborative activities require specific tools (such as forum, wiki, etc.) and specific group configurations, or *social structures*, in terms of number, dimension, composition and participants' tasks (Persico & Sarti, 2005; Alvino et al., 2009).

All the heuristics and good practices characterizing the scaffolding described above should be supplied to teachers gradually, so they can be integrated step-by-step into their mental ID model.

## 5. FUTURE RESEARCH DIRECTIONS

The multidimensional scaffold presented in this work is a conceptual framework which is useful for guiding teacher trainers in their task of supplying the necessary support to novices and unskilled teachers as they build their own mental ID model, especially when involved in the design of processes based on NBET. Although the joint effect of theory and practice, together

with effective educational resources and individual and collaborative activities (such as case-study, designing and meta-analysis) could successfully support teachers, new research directions are currently showing potential advances in the ID field related to *Computer-Aided Instructional Design (CAID).*

In particular, new research lines are investigating the possibility of embedding the above-mentioned innovative ID models and best practices in a new generation of software which are able to support unskilled teachers in the process of designing a material, an activity or a course. These systems would provide a further important scaffold, guiding the user through the different phases of the design process, by means of a user-friendly interface.

Currently, new research lines focused, for instance, on the formalization of CSCL scripts, are systematically translated into practice only by initiatives which implement *Learning Design*-based (IMS, 2003) authoring tools and platforms (such as *Recourse Learning Design Editor* or *LAMS - Learning Activity Management System*). The LD theories aim to structure the learning process by modelling reusable Units of Learning which are represented by means of formal languages (*EML - Educational Modelling Languages*) and are thus interpretable also by automatic agents. (Koper, 2001). Unfortunately, the Learning Design standard (IMS-LD) (IMS, 2003) has shown important limitations when modelling collaborative processes based on NBET, since in the current version of IMS-LD there is no way to directly represent groups as "entities"; this limitation leads to some difficulties in modelling collaborative learning processes, since these involve, among other things, the definition of groups or the structuring of the flow of collaborative learning activities (Miao et al., 2005).

Other initiatives aimed at improving and integrating the IMS-LD have demonstrated that macro-scripts, when embedded in the interface of CAID design tools (see e.g. *COLLAGE* (Hernandez-Leo et al., 2006))[7], could provide a useful support in the design process (Hernández-Leo et al., 2006).

In addition, current trends are showing the effective role of *diagram-based graphical representation of ID best practices and CSCL scripts* in CAID tools. In fact, formalisms such as UML diagrams, conceptual maps, flowcharts, decision trees, etc. are widely used in education to represent and clarify complex relationships or flows characterizing educational processes based on NBET. For instance, Alvino et al. (2009) provided evidence for the useful support offered by a new formalism for modelling and visualizing social structures involved in a CSCL activity,

called *Social Structure Representation* (SSRs). SSRs are diagrams whose aim is to complement existing CSCL scripts with hints and best practices concerning the design of collaborative groups' social structures (in terms of number of groups, dimension, composition, etc.) for a particular learning environment (including resources, tools and services). Similarly to this proposal for the use of SSRs, there are other research initiatives (Paquette, 2005; Persico & Sarti, 2005) which deal with visual artefacts for supporting educational modelling and instructional design tasks.

Future research should take into account the potential of embedding Educational Technology ID models and CSCL scripts in CAID systems. Via a user-friendly interface, these best practices could underpin the design process performed by the teacher, even fostering the interiorization of those practices. During the ID process, innovative systems could dynamically show (for instance through formalisms such as SSRs) all the implications of the teacher's decisions on the educational process in terms of (structural and heuristic) constraints, thus supporting a highly-aware authoring process. Lessons resulting from the instantiation of CSCL scripts could be stored in a repository (integrated into the CAID system) and shared as well the LOs they suggest to use, thus favouring the generation of a teacher community.

## 6. CONCLUSIONS

The introduction of NBET into higher education is a long process which is strongly conditioned by many variables, such as, for instance, the actual skills of faculty members in the educational uses of ICT and in the related instructional design approaches. Furthermore, teachers' initial experiences of using NBET are generally awkward, thus it would be useful to provide them with support in their choice of methods, in accordance with the learning objectives.

For this reason, the chapter highlights two key conditions for fostering the process of spreading NBET, and especially NCL, in higher education:

- the setting up of *ad hoc* faculty training courses aimed at introducing Educational Technology Instructional Design to teachers and at laying the foundations for regular use of these methodologies;
- providing teachers with a direct and an indirect scaffolding when involved in their first experiences as instructional designers of NCL activities and courses based on NBET.

Teachers should be made aware that their role will change when adopting NBET approaches. In fact, although teachers continue to play a central role in TEL, their role inevitably tends to change from a traditional teacher to a facilitator of the learning process: this figure is expected to provide learners with both a direct support, concerning contents, methodologies and coordinating issues, and an indirect scaffold based on a set of resources, practices, models and tools made available to them. This change can be observed particularly when NCL approaches are adopted; in fact, NCL activities cannot draw on the same criteria which underpin face-to-face collaborative learning. In this perspective, academic teachers need to master NBET methods and interiorize heuristics aimed to exploit those dynamics that make computer mediated communication (CMC) an effective learning strategy.

Once outlined the main issues and dynamics which have conditioned the rare and limited adoption of NCL methodologies in higher education, this chapter has proposed an innovative solution to Educational Technology ID teacher training, aimed at fostering their wider diffusion. This approach requires the teacher trainer to manage direct and indirect support and to propose theory and practice in a flexible way, gradually introducing elements of complexity and variability and progressively fading out the scaffolding. To provide the described multidimensional scaffolding, teacher trainers should be expert instructional designers who master NBET methods and best practices for the design of CSCL and NCL experiences, as well as the know-how to use the main resources, models and tools which could support unskilled teachers in the design process. In addition, NBET methods, CSCL and NCL should be learnt firsthand, so faculty training should include active and collaborative online activities, such as case study, problem-solving, learning-by-designing, etc. Setting up effective faculty training courses therefore requires particular attention both in choosing the teaching staff, and in defining the learning and communication management tools.

Important support in carrying out these initiatives could come from CAID systems. The chapter outlines a number of research lines investigating different ways of providing unskilled teachers with a computer-based scaffolding which is able to guide them throughout the ID process. Some of these research lines continue to comply with the IMS-LD standard, trying to improve and integrate it, others try to overcome its limitations. These research directions, especially those dealing with diagram-based or visual artefact-based graphic representation of ID best practices,

could effectively enhance the integration of Educational Technology Instructional Design into teachers' practice, and consequently integration of NBET and NCL into higher education.

## 7. REFERENCES


Adam, P., & Warren, L. (2008). A strategy for educational technology in higher education. *Journal of Computer Assisted Learning*, 10(1), 50-54.

ADL - Advanced Distributed Learning Initiative (2004). *SCORM 2004 – v. 1.3*. Retrieved July 10, 2010, from http://www.adlnet.gov/downloads/205.cfm

Alvino, S. (2008). *Computer Supported Collaborative Learning e riusabilità: un approccio all'integrazione di risorse riusabili in processi di apprendimento collaborativo* [CSCL and reusability: an approach to the integration of reusable resources in collaborative learning processes]. Unpublished doctoral thesis, University of Genoa, Genoa, Italy.

Alvino S., Forcheri P., Ierardi M.G., & Sarti L. (2008). Describing learning features of reusable resources: a proposal. *International Journal of Social Science*, 2(3), 156-162.

Alvino S., Asensio-Perez J.I, Dimitriadis Y., & Hernandez-Leo D. (2009). Supporting the reuse of effective CSCL learning designs through social structures representations. *Distance Education - Special Issue on Learning Design*, 1475-0198, 30 (2), August 2009, 239 – 258.

Attwell, G. (2005). *E-learning and sustainability. EdTechPost: Technology for Learning, Thinking and Collaborating.* Retrieved June 30, 2010, from: http://www.ossite.org/Members/GrahamAttwell/sustainibility/attach/sustainibility4.doc

Attwell, G. (2007). The Personal Learning Environments: the future of eLearning? eLearning Papers, 2(1). Retrieved June 30, 2010, from: http://www.elearningeuropa.info/files/media/media11561.pdf

Bates, T. (2003). *Higher education and elearning: Integration or change?* Presentation. University of British Columbia. Retrieved April 30, 2010 from: http://bates.cstudies.ubc.ca/

Briggs, S. (2005). Changing roles and competencies in academics. *Active learning in higher education*, 6, 256-268.

Brown, A., & Palincsar, A. (1989). Guided cooperative learning and individual knowledge acquisition. In L.B. Resnick (Ed.), *Knowing, Learning, and Instruction* (pp. 393-451). Hillsdale, NJ: Lawrence Erlbaum.

Bruffee, K.A. (1999) C*ollaborative learning: Higher education, interdependence, and the authority of knowledge*. Baltimore: Johns Hopkins University Press.

Bronfenbrenner, U. (1979). *The ecology of human development*. Cambridge, MA: Harvard University Press.

Clark, D. (1995). *Introduction to Instructional System Design. Performance, Learning, Leadership, & Knowledge*. Retrieved June 13, 2010, from http://www.nwlink.com/~donclark/hrd/sat1.html

Collazos, C., Guerrero, L., Pino, J. & Ochoa, S. (2004). A method for evaluating computer-supported collaborative learning processes. *International Journal of Computer Applications in Technology*, 19, 151-161.

Collins, B., & Van der Wende, M. (2002). *Models of technology and change in higher education: an international comparative survey on the current and future use of ICT in higher education*. Technical Report. Enschede, The Netherlands: University of Twente, Center for Higher Education Policy Studies.

Creighton, J. V., & Buchanan, P. (2001). Toward the e-campus: using the Internet to strengthen, rather than replace, the campus experience. *EduCause Review*, 36, 12-13.

Culligan, M. (2003). Digital natives in the classroom. In B. Hoffman (Ed.), *Encyclopedia of Educational Technology*. Retrieved October 28, 2010, from: http://www.etc.edu.cn/eet/eet/articles/learnstrategy/

Daradoumis, T., & Marquès, J.M. (2000). A methodological approach to networked collaborative learning: design and pedagogy issues. In M. Asensio, J. Foster, V. Hodgson, and D. McConnell (Eds.), *Proceedings of the 2000 International Conference on Innovative Approaches to Lifelong Learning and Higher Education through the Internet*, Lancaster, England, 72 - 77.

Davies, H.C., & Fill, K. (2007). *Embedded blended learning in university's teaching culture: experiences and reflections*. Retrieved October 28, 2010, from: http://eprints.ecs.soton.ac.uk/14600/

DCMI - Dublin Core Metadata Initiative (2003). *Dublin Core Metadata Element Set, Version 1.1: Reference Description*, Retrieved January 30, 2010, from: http://www.dublincore.org/documents/dces/

De Vries, L., Naidu, S., Jegede, O., & Collis, B. (1995). On-line professional staff development: an evaluation study. *Distance Education*, 16(1), 157-173.

Dillenbourg, P., & Hong, F. (2008). The Mechanics of Macro Scripts. *International Journal of Computer-Supported Collaborative Learning*, 3-1, March, 2008. New York: Springer. Retrieved January 03, 2010, from http://www.springerlink.com/content/9q14234gx52x1784/

Elliot, B. (2008). *E-pedagogy: does e-learning require a new approach to teaching and learning?* Retrieved March 28, 2010 from: http://d.scribd.com/docs/22rc8wz72z067xrb1fpk.pdf

Felder, R., & Brent, E. (2001). Effective strategies for cooperative learning. *Journal of Cooperation and Collaboration in College Teaching*, 10 (2), 66-75.

Fink, L.D. (1999). *Active learning. Oklahoma Instructional Development Program*. Retrieved January 30, 2010, from http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/active.htm

Foshay, W.R., Silber, K.S., & Stelnicki, M.B. (2003). *Writing training that works*. San Francisco: Pfeiffer/Jossey-Bass.

Garrison, D.R. (2003.). Self-directed learning and distance education. In M.G. Moore and W.G. Anderson (Eds.), *Handbook of Distance Education* (pp.113-127). New Jersey: Lawrence Erlbaum Associates, Inc., Publishers.

Grant, M.M. (2004). Learning to teach with the web: factors influencing teacher education faculty. *The Internet and Higher Education*, 7, 329-341.

Gunawardena, C.N. (1995). Social presence theory and implications for interaction and collaborative learning in computer conference. *International Journal of Educational Telecommunications*, 1(2/3), 147-166.

Hernández-Leo, D., Villasclaras-Fernández, E. D., Asensio-Pérez, J. I, Dimitriadis, Y., Jorrín-Abellán, I. M., Ruiz-Requies, I., & Rubia-Avi, B. (2006). COLLAGE: A collaborative Learning Design editor based on patterns. *Educational Technology & Society*, 9 (1), 58-71.

Howell, S.L., Williams, P.B., Lindsay, N.K., & Laws, R.D. (2004). Trends affecting Distance Education and Distance Learning. *Online Journal of Distance Learning Administration*. Retrieved March 28, 2010, from: http://www.teenet.net/thirtytwotrends.htm

IEEE - Learning Technology Standards Observatory (2002). *Learning Object Metadata*. Retrieved June 13, 2010, from http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf

IMS (2003). *Learning Design v 1.0 Final Specification*. Retrieved June 22, 2010, from http://www.imsglobal.org/learningdesign/index.cfm

Januszewski, A. & Molenda, M. (Eds.) (2008). *Educational technology: A definition with commentary*. New York: Lawrence Erlbaum Associates.

Jonassen, D.H. (2008). Instructional Design as Design Problem Solving: An Iterative Process. *Educational Technology*, 48 (3), may-june 2008, 21-26.

Kirkwood, A. (2009). *E-learning: you don't always get what you hope for*, 18(2), july 2009, 107-121.

Klobas J., Renzi S., & Trentin G. (2008). Approaching TEL in university teaching: trends and faculty training need. In Kendall, M., & Samways, B. (Eds.) *Proceedings of the WCC 2008*, Milan 8-10 September, pp. 145-148, Springer, NY.

Kobbe, L., Weinberger, A., Dillenbourg, P., Harrer, A., Hämäläinen, R., & Fischer, F. (2007). Specifying computer-supported collaboration scripts. *International Journal of Computer-Supported Collaborative Learning*, 2 (2-3), 211-224.

Koper, E.J.R. (2001). *Modelling Units of Study from a Pedagogical Perspective: the pedagogical metamodel behind EML*, Heerlen: Open Universiteit Nederland. Retrieved June 01, 2010, from http://eml.ou.nl/introduction/docs/ped-metamodel.pdf

Koschmann, T.D. (1996). *CSCL: Theory and Practice of an Emerging Paradigm*. New Jersey, Lawrence Erlbaum Associates.

Kreijns, K., & Kirschner, P.A. (2004). Determining sociability, social space, and social presence in (a)synchronous collaborative teams. *Cyberpsychology and Behavior*, 7(2), 155-172.

LAMS - Learning Activity Management System website http://www.lamsinternational.com/, last visited: October 2010.

Longmire, W. (2000). *A Primer on Learning Objects*. Retrieved October 28, 2010, from http://www.astd.org/LC/2000/0300_longmire.htm

MacDonald, J. (2008). *Blended Learning and Online Tutoring*. Aldershot, UK: Gower.

Miao, Y., Hoeksema, K., Hoppe, H. U., & Harrer, A. (2005). CSCL scripts: Modelling features and potential use. In Koschmann, T., Suthers, D., & Chan, T. W. (Eds.), *Proceedings of the Computer Supported Collaborative Learning 2005*: *The Next 10 Years!* (pp. 423-432). Mahwah, NJ, USA: Lawrence Erlbaum.

Naisbitt, J. (1984). *Megatrends: ten new directions changing our lives*. New York: Warner Books.

Paquette, G., Léonard, M., Ludgren-Cayrol, K., Mihaila, S., & Gareau, D. (2005). Learning Design based on Graphical Modelling. *Educational Technology & Society*, 9(1), 97-112. Retrieved January 13, 2010, from http://ares.licef.teluq.uqam.ca/Portals/29/docs/pub/ingenierie/Graphic%20Knowledgebased%20V2.pdf

Palloff, R.M., & Pratt, K. (2005). *Collaborating online: Learning together in community*. San Francisco: Jossey-Bass.

Palloff, R.M., & Pratt, K. (2010). Faculty Training and Mentoring at a Distance: Learning Together in the Virtual Community. In Luppicini, R., & Haghi, A.K. (Eds.), *Cases on digital technology in higher education*, Hershey, Pennsylvania: IGI Global, 111-125

Paulson, K. (2002). Reconfiguring faculty roles for virtual settings. *The Journal of Higher Education*, 73, 123-140.

Pedagogical Pattern Project website http://www.pedagogicalpattern.org, last visited: October 2010

Persico, D. & Sarti, L. (1995). Social structures for online learning: a design perspective. *Proceedings of Conference on Methods and Technologies for Learning*, Palermo, Italia, 51-60.

Recourse Learning Design Editor website http://tencompetence-project.bolton.ac.uk/ldauthor/index.html, last visited: October 2010

Reigeluth, C.M. (Ed.) (1999). *Instructional design theories and models. Vol. 2. A new paradigm for instructional design theory*. Mahwah, NJ: Lawrence Erlbaum Associates.

Reigeluth, C.M., Molenda M. & Nelson L.M. (2003). Instructional design. In Nadel L. (Ed.) (2003), *Encyclopedia of Cognitive Sciences*, vol. 2, pp.574-578.

Salmon, G. (2002). *E-tivities: the key to active online learning*. London, UK: Kogan Page.

Salmon, G. (2004). *E-moderating: the key to teaching and learning online*. London: Kogan Page.

Sauter, V. L. (2003). Web design studio: a preliminary experiment in facilitating faculty use of the web. In A.K. Aggarwal (Ed.), *Web-Based Education: learning from experience* (pp. 131-154). Hershey, PA: Information Science Publishing.

Seufert, S., & Euler, D. (2003). Sustainability of eLearning innovations: findings of expert interviews. Retrieved January 13, 2010, from http://www.scil.ch/publications/docs/2003-06-seufert-euler-sustainability-elearning.pdf

Shamsuar, N. (2008). *Multimedia in computer-aided learning application: usage and effectiveness*. Saarbrücken: VDM.

Silber, K.H. (2007). A Principle-based Model of Instructional Design: A New Way of Thinking About and Teaching ID. *Educational Technology*, 47 (5), september-october 2007, 5-19.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences*. Cambridge, UK: Cambridge University Press, 409-426.

TELL project website, http://cosy.ted.unipi.gr/tell/, last visited: October 2010.

Trentin G. (2001). Designing Online Courses. In Maddux, C.D., & LaMont Johnson, D. (Eds.), *The Web in Higher Education: Assessing the Impact and Fulfilling the Potential* London, Oxford: The Haworth Press Inc. 47-66.

Trentin, G. (2006). The Xanadu Project: Training Faculty in the Use of ICT for University *Teaching. International Journal of Computer Assisted Learning*, 22, 82-196.

Trentin, G. (2008). Technology Enhanced Learning and University Teaching: Different Approaches for Different Purposes. *International Journal on E-Learning*, 7 (1), 117-132.

Trentin, G. (2010). Network Collaborative Learning: Social Interaction and Active Learning. Chandos Publishing Limited, Oxford, UK.

Tripp, S., & Bichelmeyer, B. (1990). Rapid prototyping: An alternative instructional design strategy. *Educational Technology Research and Development*, Volume 38, Number 1 / March 1990.

VandenBos, G., Knapp, S., & Doe, J. (2001). Role of reference elements in the selection of resources by psychology undergraduates. *Journal of Bibliographic Research, 5*, 117-123. Retrieved October 13, 2001, from http://jbr.org/articles.html

Vygotsky, L.S. (1978). Mind and society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Wiley, D.A. (2001). The Instructional Use of Learning Objects. Retrieved July 10, 2010, from http://reusability.org/read/

Weinberger, A., Collar, I., Dimitriadis, Y., Mäkitalo-Siegl, K., & Fischer, F. (2008). Computer-supported collaboration scripts: Theory and practice of scripting CSCL. Perspectives of educational psychology and computer science. In N. Balacheff, S. Ludvigsen, T. d. Jong, A. Lazonder, S. Barnes & L. Montandon (Eds.), *Technology-Enhanced Learning. Principles and Products*: Springer Verlag, 155-174

Young, J. R. (2002). 'Hybrid' teaching seeks to end the divide between traditional and online instruction. *The Chronicle of Higher Education*. Retrieved May 30, 2010, from http://chronicle.com/free/v48/i28/28a03301.htm

Zemsky, R., & Massy, W.F. (2004). *Thwarted innovation: what happened to e-learning and why*. Final Report for The Weatherstation Project of the Learning Alliance at University of Pennsylvania. Retrieved June 01, 2010, from http://www.csudh.edu/dearhabermas/WeatherStation_Report.pdf

## 8. ADDITIONAL READING SECTION

Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In Kirschner P. A. (Ed), *Three worlds of CSCL. Can we support CSCL,* Heerlen: Open Universiteit Nederland, 61-91.

Gustafson, K.L., & Branch, R. (2002). *Survey of instructional design models* (4th ed.). Syracuse NY: ERIC.

Littlejohn, A. (ed.) (2004). *Reusing online resources*. London: Kogan Page

Rowland, G. (1992). What do instructional designers actually do? An initial investigation of expert practice. *Performance Improvement Quarterly* 5(2): 65–86.

## 9. KEY TERMS & DEFINITIONS

COMPUTER SUPPORTED COLLABORATIVE LEARNING (CSCL) - An emerging branch of the learning sciences concerned with studying how people can learn together with the help of computers. CSCL is based on the concept of collaborative learning as the mutual engagement of participants in a coordinated effort to pursue a specific learning goal.

CSCL SCRIPT - A CSCL script computationally specifies, sequences, and distributes the roles and activities involved in a computer-supported collaborative learning situation, thus providing a certain degree of scaffolding for fostering learners' engagement in more potentially effective interactions. Collaboration scripts aim to foster collaborative learning in shaping the way in which learners interact with one another, thus triggering engagement in social and cognitive activities that would otherwise occur rarely or not at all.

EDUCATIONAL TECHNOLOGY: the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources.

EDUCATIONAL TECHNOLOGY INSTRUCTIONAL DESIGN: a branch of theoretical and practical knowledge which identifies the main theories, principles and best practices to design learning processes based on specific educational models and strategies (deriving from the main learning theories) and enhanced by the integration of specific technologies, such as ICT.

INSTRUCTIONAL DESIGN (ID) - Instructional Design is a branch of theoretical and practical knowledge which identifies and models the rules governing the choice of the most suitable learning methods for the pursuit of specific educational goals, taking into account the context-related variables and limitations.

LEARNING OBJECT (LO) - Any digital resource that can be reused to support learning, and integrated by a teacher into the learning process he/she is designing so as to enrich it; learning

objects can be generated with explicit educational purposes, such as tutorials, self-learning units and modules, but also as case studies, webquests, simulations, etc., or not; in the second case they are normally integrated in the learning process as reference resources, such as scientific papers, digital book chapters, glossaries, FAQ lists, etc.

NETWORK-BASED EDUCATIONAL TECHNOLOGY (NBET) - The specific area of ET which focuses on the educational use of network technology.

NETWORKED COLLABORATIVE LEARNING (NCL) – A learning approach supported by a computer network and (above all) underpinned by a network of inter-relationships that link up the learners along the educational process. These inter-relationships help the members of a learning community to collaborate together in pursuit of a specific learning goal. So the network should be considered primarily as a network of individuals rather than merely a computer network for distance communication between the same individuals.

SCAFFOLDING - The concept of scaffolding derives from constructivist theories and is closely bound up with the supposed need of learners to have recourse to external human, technical and organisational support systems in order to exercise and expand their inner potential. These support systems may develop on both the intellectual, social and affective planes, and may derive either from the direct action of the teacher or an indirect action. The latter consists in the setting up, preparation and continual integration into the learning environment of learning and support tools and resources which facilitate the learning process.

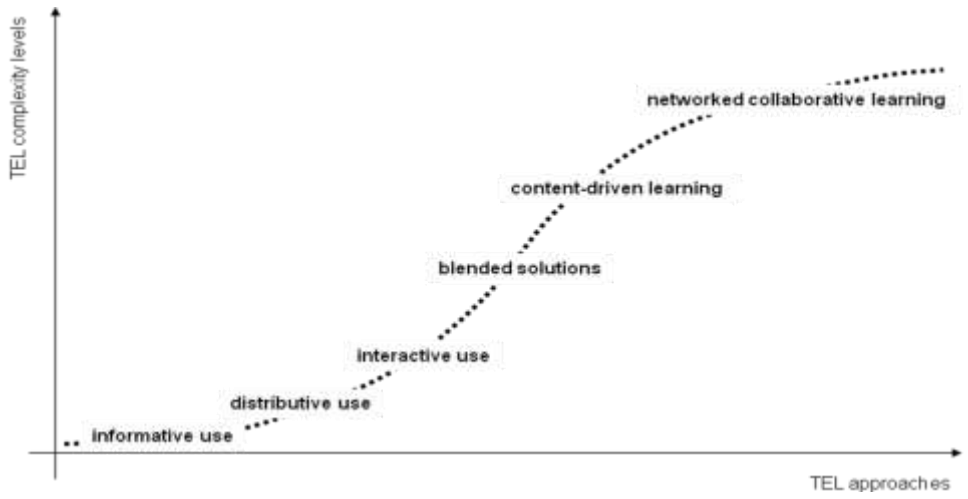


Fig. 1 – A possible taxonomy of the main TEL approaches in higher education

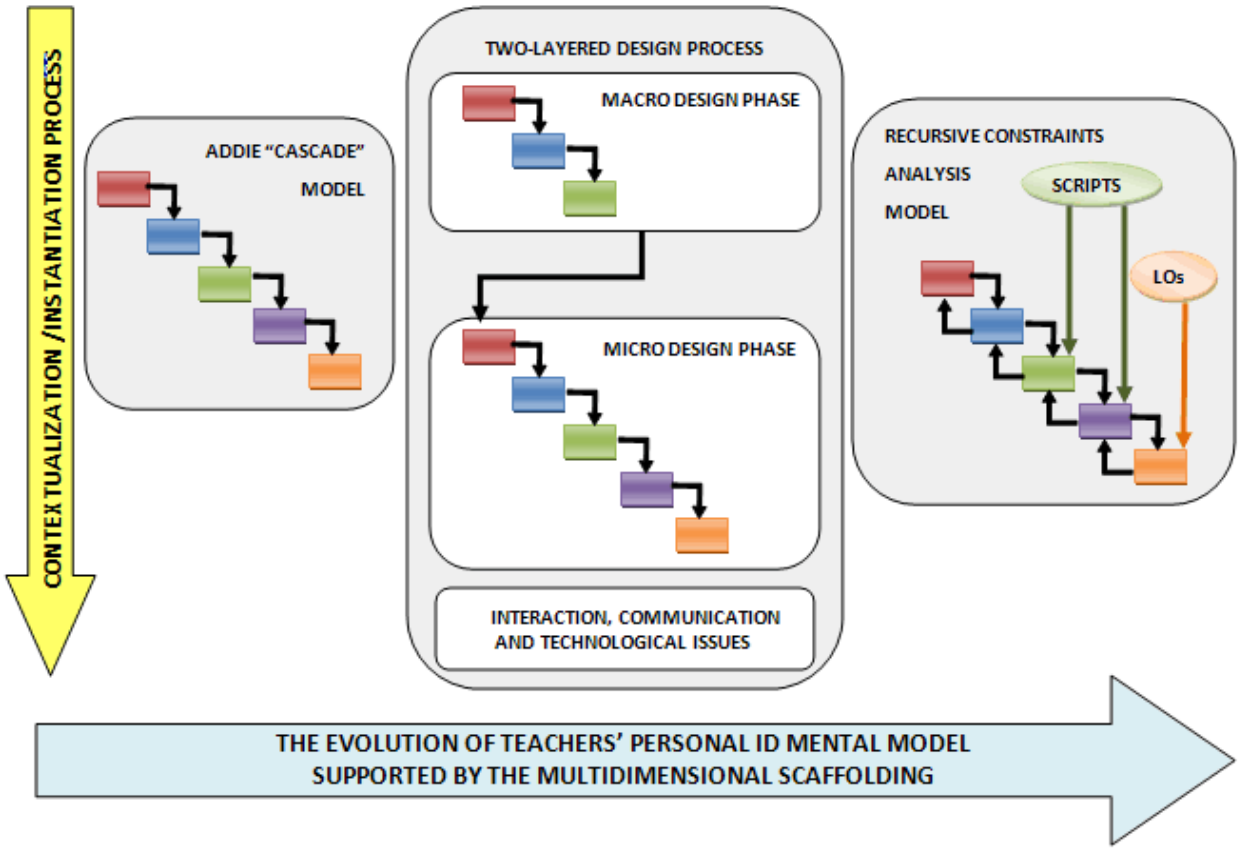


Fig. 2 – A comparison of three ID models: the ADDIE model, the two-layered design model and the *Recursive Constraints Analysis* model

[1]. Association for Educational Communications and Technology.
[2]. Learning Management System.
[3]. Content Management System / Course Management System.
[4] The overview is the result of various studies carried out in several Italian university between 1999 and 2006
[5]. The URL of the main repositories cited in this section are: Merlot http://www.merlot.org; Ariadne Knowledge Pool: http://ariadne.cs.kuleuven.be/silo2006/NewFederatedQuery.do; the GEM Catalog http://www.thegateway.org/browse; The Pedagogical Pattern Project: http://www.pedagogicalpatterns.org/; Curriki: http://www.curriki.org; EDSITEment: http://edsitement.neh.gov/; Education World: http://www.education-world.com/a_lesson/index.shtml
[6]. ADDIE is an acronym deriving from the main phases of the model itself: Analysis, Design, Development, Implementation, Evaluation
[7]. Collage, a high-level IMS-LD compliant authoring tool that is specialized for CSCL Collage helps teachers in the process of creating their own potentially effective collaborative Learning Designs by reusing and customizing patterns, according to the requirements of a particular learning situation. These patterns, called Collaborative Learning Flow Patterns (CLFPs), represent best practices that are repetitively used by practitioners when structuring the flow of (collaborative) learning activities.