Approaching pedagogical planning in learning design

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In recent years those engaged in learning design research and development have also started looking at how to take account of and adequately encompass the critical area of pedagogical planning [1, 2], which underpins truly effective teaching-learning process. Besides the specifications and tools currently available for representing and enacting a unit of learning (e.g. IMS-LD), the need emerges for a model that fosters the designer's reflection on the fundamentals underpinning the proposed learning activities and on the impact of the theoretical framework that has been adopted. In this paper we present the idea of a "pedagogical scenario", a dynamic and modular vehicle for pedagogical planning that encompasses the viewpoints and concerns of teachers, researchers and computer scientists engaged in educational innovation.

Keywords pedagogical scenario; learning design; pedagogical planning.

1. Introduction

When computers were first being introduced in education, the transmissive paradigm of teaching and learning that prevailed at that time remained largely unaffected by the introduction of this new technology. For quite some time ICT was mainly seen as a means for delivering contents to students, and attention was mainly fixed on efforts to parcel learning contents in reusable "learning objects" (LOs) and to create learning management systems (LMS) for managing LOs and making them available to students. This turned out to be propulsive for the development of a number of standards (IEEE-LOM, ARIADNE-SCORM, Dublin Core, etc.) whose aim was to provide specifications and standards for describing LOs via metadata and making them universally available for learning[1].

More recently, however, the field of technology-enhanced learning (TEL) has progressively taken on board theories which emphasize the social and situated dimensions of learning [3] and has increasingly come to consider learning as a complex process that takes place within a structured and complex learning environment [4]. Consequently, research in the TEL sector has started to focus on the redefinition not just of contents and goals, but also of the learning environment in its complexity. In this perspective, it can be an arduous task for the individual teacher to design a technology-enhanced learning environment that may well bring with it the need for change and innovation in teaching practices. Indeed, in experimental activities involving the integration of ICT in teaching practice, it is not uncommon for teachers to work together and with research teams on defining meaningful contexts of use and on analyzing results. Furthermore, teachers are increasingly forming and joining communities of practice devoted to sharing best practices and know-how in the field.

The emergent need for the designer[2] to reflect critically on the pedagogical and contextual aspects affecting an ICT-based learning event is widely demonstrated by increasing efforts to develop models and tools for sharing and capitalizing on the know-how in the design of learning activities. One example is the concept of "Design Patterns", which has been borrowed from the architecture field [5] and widely tested in many research projects[3]. Design Patterns "describe a problem that occurs over and over again in

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[1] For further references see http://ferl.becta.org.uk/display.cfm?page=307

[2] In this paper we use the term "designer" to refer to anyone engaging in the design of a learning experience, including teachers, educators, pedagogical experts, researchers, etc.

[3] Recent projects concerning the application of Design Patterns in education include: E-LEN (http://www2.tisip.no/E-LEN/), Pedagogical Patterns (http://www.pedagogicalpatterns.org/), Design patterns for recording and analyzing usage of learning systems (http://www.noe-kaleidoscope.org/pub/activities/jeirp/activity.php?wp=33)

an environment, and then describe the core of the solution to that problem, in such a way that you can use this solution a million times over" [5]. In other terms, Design Patterns are used in the education field as a semi-formal way for describing design problems and sharing possible solutions: they are often used in educational designers' communities of practice for exchanging know-how in the e-learning sector.

Furthermore, recent studies [1, 2] have pointed to the need to provide designers with ICT-based tools capable of offering support for pedagogical planning process. This is the direction that ITD has been pursuing over the past few years within various national and international projects[4] specifically dedicated to the matter. This experience clearly indicates that ICT-based support offers designers a range of benefits, not only in terms of more effective pedagogical planning, but also in the greater potential for exchanging views and sharing valuable experience with others within a community, including design reuse and adaptation.

In this paper, we present the idea of a "pedagogical scenario" in the embryonic state of development it has reached thus far within the European REMATH project. The conceptual model is intended as a way to support the designer's reflections on the pedagogical and contextual aspects that determine and influence the efficacy of an ICT-based learning experience.

2. From the "unit of learning" to the "pedagogical scenario"

Our current concerns in the field of representing design problems are centred on REMATH, a European Community funded project[5] that is part of the Information Society Technologies priority (IST) of the 6th Framework Programme. This project aims to build an integrated theoretical and operative framework for mathematics learning through ICT-based representation of mathematical meanings. In efforts towards achieving and demonstrating this integration, European researchers from different national teams have been asked to develop educational software applications based on the theoretical frameworks underpinning their approach to mathematics teaching and learning. The idea is that teams will carry out cross-experimentation to compare both the tools themselves and the theoretical framework adopted in their development. As the project's basic assumptions stress the importance of the learning process, comparison and discussion will not occur at tool level, but rather will be based on exchange among researchers about the learning processes activated through the use of the developed tools. Furthermore, discussion is intended to involve both specialist mathematics researchers as well as those in the field of education technology, so as to enhance dialogue not only on a content and epistemological level, but also at a pedagogical and didactical level.

As our specific responsibility in the project is to provide suitable means for the teams to describe and represent ICT-based learning activities, we began by examining existing Educational Modelling Languages and related applications. The most well-known initiative is EML[6], is a notation system developed by the Open University of the Netherlands (OUNL) in the late nineties for describing "units of learning", which are "atomic or elemental units providing learning events for learners, satisfying one or more interrelated learning objectives" [6]. More recently, EML has been selected as a basis for IMS Learning Design 1.0[7], which was approved as an official IMS Final Specification in 2003 [6, 7]. According to the specifications, "in a unit of learning people act in different roles in the teaching-learning process, working toward certain objectives by performing learning and/or support activities within an environment, consisting of learning objects and services to be used during the performance of the activities" [6]. In the past few years, this new vision has given rise to the development of tools designed to validate the IMS-LD specification itself and to explore its potential in educational settings; the tools developed include

[4] SD2 - http://www.sd2.itd.cnr.it/; NETFORM2 - http://www.netform2.itd.cnr.it/; ASD http://asd.itd.cnr.it/; REMATH - http://remath.cti.gr/default_remath.asp
[5] http://remath.cti.gr/default_remath.asp
[6] http://eml.ou.nl/eml-ou-nl.htm
[7] http://www.imsglobal.org/learningdesign/index.html

both "editors" enabling the author to create units of learning and "players" for delivering those units to students and running them8.

As Koper reminds us, the IMS-LD specification "aims to represent the learning design of units of learning in a semantic, formal and machine interpretable way" [8], which is to say that the designer's efforts are focused on using the technology to create learning environments designed for direct use by learners. Interesting results are being obtained in this area and these are providing stimulus for further considerations.

Nonetheless, our attention is directed not so much to the possibility that IMS-LD offers for producing runtime executable code, but rather concentrates on how ICT may be usefully employed in supporting the design phase of an innovative learning process and in fostering all those pedagogical and contextual reflections that are at the heart of an enacted experimental unit of learning. In other terms, we feel the need for a model that fosters designer reflection on the fundamentals underpinning the proposed learning activities and on the impact of the theoretical framework that has been adopted. At the same time we think it is important to help the designer make basic assumptions explicit and explain his/her pedagogical choices. This would not only facilitate fruitful exchange among teachers but would also foster dialogue and transfer of acquired know-how within a learning community comprising teachers, researchers, pedagogical experts, etc.

In the following we highlight the main attributes that may converge in a conceptual model encompassing support for reflection in the process of ICT-based learning design.

3. A conceptual model for the pedagogical scenario

The term "scenario" is not new in the e-learning sector, and has been used to denote a range of concepts: it is sometimes adopted as a synonym of the IMD-LD unit of learning, while elsewhere it can cover anything that has something to do with educational planning. According to Peter and Vantroys [9] the pedagogical scenario "defines the activities which must be done by the learners and the tutors, the sequencing of these activities as well as the learning objects and tools that should be provided to the different actors". Schneider [10] defines "a pedagogical scenario as a sequence of phases within which students have tasks to do and specific roles to play". A different perspective is assumed by Pernin and Lejeune [11], who define their "learning scenario" as a "description, carried out *a priori* or *a posteriori*, of the playing out of a learning situation or a unit of learning aimed at the acquisition of a precise body of knowledge through the specification of roles and activities, as well as knowledge handling resources tools, services and results associated with the implementation of the activities." Enlighteningly, the authors propose a taxonomy of different scenario types:

-*prescriptive scenarios* that are established a priori by the designer, initially in the form of abstract scenarios and subsequently as contextualized scenarios;

-*descriptive scenarios*, which report the actual run of the contextualized scenario and can be adapted for reuse in accordance with individual needs;

-*decontextualized scenarios*, which result from comparison between the prescriptive and the descriptive scenarios, and can be catalogued and indexed for search, adaptation and reuse.

In response to the particular demands of the REMATH project, the idea of the pedagogical scenario that we have pursued is of a dynamic and modular vehicle for pedagogical planning that encompasses the viewpoints and concerns of teachers, researchers and computer scientists engaged in educational innovation. Thus the pedagogical scenario is designed to be an extremely flexible entity capable of embracing both simple plans for single activities as well as very complex structures with activities of different type arranged into different levels. This flexibility is achieved by defining a scenario as a tree-like hierarchy made up of simpler, elementary scenarios (the leaves of the tree - see Fig. 1) and expressing these using a common set of descriptors.

[8] Examples of projects and tools include aL.Fanet LD Editor and Player (aL.Fanet project), CopperAuthor Editor and Engine (OUNL), RELOAD Editor and Player (RELOAD project), LAMS (LAMS Foundation, AU), UNFOLD Project, etc.

Each node of the tree (for instance ES2 in Fig.1) may be interpreted either as an elementary scenario or as a sub-tree having that node as a root (in the example the leaves are ES4, ES5 and ES6). As both interpretations can be useful, we need to label them with different names; accordingly, we refer to the first case as "the elementary scenario ES2" and to the second case as "the scenario ES2". Rules of order and optionality can be applied to the nodes within a scenario so as to allow for complex activity structures.

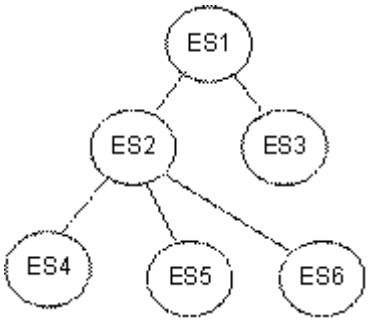

Fig. 1 Tree structure of a REMATH pedagogical scenario

The descriptors of the elementary scenario address the reason why a learning activity (or set of activities) is proposed, the way in which it is to be carried out and the innovative aspects it is intended to enhance. This means that the conceptual model needs to include not only the attributes required for enacting the learning activity (already represented by IMS-LD), but also a number of further descriptors for making explicit certain design problems and for fostering reflection on the adopted solutions. The descriptors of an elementary scenario have being gathered into four categories: identity, rationale, target and specification.

The "Identity" descriptors cover general information (i.e. name, title, author, description, subject, topic, language, country, keywords) that is useful for identifying and classifying a scenario, as well as for managing it computationally (storing, retrieving, etc.).

"Rationale" describes both the rationale underpinning the proposed scenario (the author's primary motivation, significant innovative aspects of the proposal, etc.) and of the theoretical framework/s that has/have informed the design process.

"Target" comprises attributes for describing:

-the population addressed (school level, age range, description, student prerequisites, teacher prerequisites);

-the context in which that population is embedded (physical, institutional, socio-cultural);

-the educational goals to be achieved by the learner population (curricular, content-epistemological, cognitive, social-affective, instrumental goals).

"Specification" is the most detailed category in the scenario model, in that it includes:

-a description of how the adopted theoretical framework is manifest in concrete learning activity/activities;

-the tools and resources to be used by the students;

-a description of the modality of employment of the tools and their capacity to mediate towards goal achievement;

-a work plan, namely a description that takes the teacher step-by-step through the enactment process, detailing how each step is to be performed and indicating how to manage the process - this also covers details about setting, duration and process documentation.

It should be noted that the IMS-LD specification does formalize – at least partially – some of the areas that, to our way of thinking, ought to be the subject of designer reflection: for example, the specification touches on aspects like the definition of learning objectives, description of the roles of the actors involved, characterization of the target population (in terms of students' prerequisites). That said, we be-

lieve that making provision for designers to focus their efforts in crystallizing and studying these and other important aspects would clarify pedagogical planning, possibly leading to more effective designs. A crucial aspect in this regard is the possibility to make explicit the theoretical framework that underpins the whole design and which is reified in a number of areas, including the way activity is carried out. Bringing this aspect into focus may foster critical reflection on the framework itself, making it possible to identify design weaknesses and strong points and consequently suggesting adjustments in enactment. Furthermore, since the conceptual model of the pedagogical scenario allows space for the description of a wide variety of instructional approaches, testimony of the theoretical framework adopted provides a concrete basis for comparison even among widely different experiences and backgrounds (potentially involving different actors from different national and cultural contexts) in the development and sharing of designs. Description of the way the whole process is to be carried out may provide valuable scaffolding for design reuse: this is an essential aspect in the cross-experimentation foreseen in REMATH, where different ICT tools are tested and different frameworks are compared and possibly integrated through the use of scenarios.

In our vision another important aspect to consider is description of a tool's potential for mediating the achievement of learning objectives. For this reason a pedagogical scenario not only provides an indication of the tools to be used during learning activities, but also allows for detailed description of how they should be used and of their modality of employment (what functions, used by whom, how, with what procedures, etc.) .

The conceptual pedagogical scenario model under development also includes description of the context, seen in its multi-dimensional complexity, including physical, institutional and socio-cultural aspects; close attention to context may help the designer in pondering issues that can affect the likelihood of an innovation actually permeating practice, of its appropriateness in respect to the context itself, and of the conditions for replication.

In addition, it should also be possible for a scenario to be updated and modified on the basis of enactment results, and the designer should be able to maintain a history of what happens during the enactment stage (storing comments, saving logs, recording examples from the class, etc.), so as to be able to tune the scenario itself fur future plays.

4. Conclusions

In this paper we have argued that, while existing specifications and tools address the need to represent units of learning and manage their enactment, we - as researchers involved in the REMATH project - have felt the need to clarify the pedagogical and contextual aspects that affect learning designs. This is the driving impetus behind the definition of a conceptual pedagogical scenario model that explicitly seeks to embrace these matters. In our vision, basic assumptions that orient pedagogical planning can and should be brought into the foreground, and this process can be supported using suitable specifications and ICT tools for representing and managing the design phase as well. For this reason, we are presently implementing a bespoke ICT-based tool aimed at supporting the pedagogical planning efforts of designers (teachers, researchers, pedagogical experts, etc.) and to facilitate the sharing, adaption and reuse of their designs. As outlined, our work takes into account the state of the art in the field and is not intended as a complete departure from existing specifications, IMS-LD in particular; on the contrary, the two visions may coexist and we believe further reflection and reciprocal enrichment could be of great value.

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