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E²ML: A TOOL FOR TECHNOLOGY-DEPENDENT EDUCATIONAL ENVIRONMENT DESIGN

New media represent an unprecedented class of tools for teaching and learning, and their diffusion has modified the landscape of the community of teachers and educators - but between the existence of new tools and their effective exploitation in an actual educational context, there is a wide gap that the ability of the educator only can fill. How can these new tools be effectively and efficiently integrated into a learning environment, enhancing the quality of learning? Is the effort of managing new media worth, in terms of learning outcomes? One key lies in the activity of educational requirements analysis, and in the careful planning of curriculums, courses and learning activities. *Educational design* is the discipline tackling these issues, and the development of practical tools for educational design is the research topic for this Ph.D.

Object

The object of this work is the *design of technology-dependent educational environments (TDEE)*. An educational environment is a context composed by actors and roles, goals and objectives, contents and materials, spaces and tools, activities and communication flows, along with the interactions among them, where the action of teaching and learning can favorably take place. TDEEs are educational environments which owe their structure and dynamic to the availability of technological facilities, and in which the integration of technologies has become an essential part of the

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teaching and learning process: a technological breakdown would mean a significant redesign of the whole system[1].

While the definition is generally valid for any instruction level, this work will focus on Higher Education, in order to consider a more restricted – even if not at all narrow – setting, well defined by its student target, institutional context and kind of learning[2].

Perspective & Goals

TDEEs will be considered from the point of view of the designer. Intended readers are persons in charge of designing an educational environment that exploits new media as essential elements e.g. as communication channel (with forums, videoconference, distant collaborative work facilities) or for operating with specific applications (virtual reality, interactive self-test), etc. Among the others, some relevant issues at stake in educational design for TDEEs concern

1. the design, implementation and adaptation of IT to a specific educational context
2. team communication issues in the implementation of new tools for education
3. the evaluation, in terms of learning outcomes, of new media exploitation in education

This work aims at defining a proposal of a conceptual model (or metamodel) for designing TDEEs in Higher Education. The model is composed by two elements:

1. a set of concepts defining the basic elements of course design of the approach, design and procedure levels (Richards & Rodgers 1986). The concepts for describing the educational activity are defined through a theoretical and critical analysis of the learning process in it-

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[1] Why technology-dependent and not technology-based? It is often the case that (usually formal) teaching and learning activities designed as exploiting a specific tool, become impossible without it. This is true as well of environments in which technologies do not play the main role, such as in a simple lecture that requires a beamer for projecting animated slides. The lecture is not based on technology, but its effectiveness and success depend on technology all the same. The definition of TDEE allows us to consider also non-electronic, or traditional ("traditional" is of course always referred to the Western educational tradition), technologies, such as the blackboard, or photocopies, even the usual classroom setting.

[2] Namely, the academic context will be the main reference context for the work.

self (see below) and by the analysis of case studies. These concepts represent the primitives of the model.

2. a formal (UML-like) representation language, as design tool. It is intended to be a support for a structured design methodology. E²ML (Educational Design Modeling Language) is the acronym chosen for the representation language.

As a specific meta-model for educational environments, it can be used at several steps in the design process, such as for systematic educational requirement analysis, for the design of educational activities, as medium for team communication during the development phase and as reference grid for the evaluation of the learning outcomes, etc...

Research Method

The first step of the research considers teaching and learning from a theoretical point of view in order to define the primitives that will form the lexicon for the analysis of case studies and for the conceptual model. The importance of this part is paramount, as any work or action in the field of education strictly depends on the underlying idea of education and culture, as the quality of fruit depends on the soil that nurtures the tree. The main referenced authors are L.S. Vygotsky (e.g. Vygotsky 1978), J. Searle (e.g. Searle 1983), and B.S. Bloom (Bloom 1956). A synthetic view of the contributions of these authors is made following the work of B.J. Lonergan (see e.g. Lonergan 1990, Lonergan 1992, Lonergan 1993). Knowledge is enquired as an intentional activity, and learning as a three-step process for acquiring/creating knowledge, moving from *experience* through *understanding* to *judgment.* This understanding of knowledge and learning is exploited as reference grid for a precise mapping of the learning activity in an educational environment[3].

The second part of the work includes three real and currently operating TDEEs as case studies. They will be considered in two subsequent editions: the first one is analyzed, and the design model is exploited for understanding unexpected learning outcomes and for figuring out possi-

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[3] This first part was completed in July 2002, and is currently under refinement. A first presentation of these results has been published in (Botturi 2002) at the ELEARN 2002 Conference. A former draft was presented in (Botturi & Tagliatesta 2001).

ble solutions, that are then applied in the second edition. The primitives defined in the first part are proofed on real cases, attempting to analyze them in a reverse-engineering process. Moreover, this allows the defini-tion of the main *material elements* of an educational environment[4]. The selected case studies are:

1. the course *L'Istituzione nel Contesto della Società*, offered by the Uni-versity of Lugano
2. the exploitation of the SWISSLING *Verbal Semiotics* module in the course *Linguistica I* at the University of Lugano
3. The course *Teleinformàtica I* offered online by UNIVELS

The conceptual design model and the E²ML specification will be re-fined in the last part of the work, where it will be then proofed in the de-sign from scratch of an educational environment[5].

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[4] The second part of the work is currently ongoing. Identified educational elements are teaching and learning roles (and the corresponding actors), learning goals, activities, tools and communication flows.
[5] The application case is currently under selection.

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