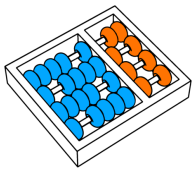

Alessandro Arpetti

"Teaching Practice and Learning Design: a Reflective Model for Professional Growth."

"*Prática de Ensino e Planejamento Didático: um Modelo Reflexivo para o Crescimento Profissional.*"

CAMPINAS
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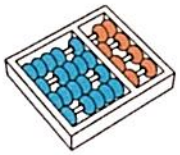

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"Teaching Practice and Learning Design: a Reflective Model for Professional Growth."

Supervisor(s)/Orientador(es)
Prof. Dr. Maria Cecília Calani Baranauskas
Prof. Dr. Tommaso Leo

"Prática de Ensino e Planejamento Didático: um Modelo Reflexivo para o Crescimento Profissional."

PhD Thesis presented to the Post Graduate Program of the Institute of Computing of the University of Campinas to obtain a PhD degree in Computer Science.

Tese de Doutorado apresentada ao Programa de Pós-Graduação em Ciência da Computação do Instituto de Computação da Universidade Estadual de Campinas para obtenção do título de Doutor em Ciência da Computação.

THIS VOLUME CORRESPONDS TO THE FINAL VERSION OF THE THESIS DEFENDED BY ALESSANDRO ARPETTI, UNDER THE SUPERVISION OF PROF. DR. MARIA CECÍLIA CALANI BARANAUSKAS.

ESTE EXEMPLAR CORRESPONDE À VERSÃO FINAL DA TESE DEFENDIDA POR ALESSANDRO ARPETTI, SOB ORIENTAÇÃO DE PROF. DR. MARIA CECÍLIA CALANI BARANAUSKAS.

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Teaching Practice and Learning Design: a Reflective Model for Professional Growth.

Alessandro Arpetti

April 04, 2014

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Abstract

The increasing use of technology in education and the failure to achieve the expected results have brought attention to the Learning Design (LD), in order to promote better educational outcomes and a more profitable use of technology. LD is a complex activity that requires a large number of competences. In recent years, research in the field has led to the development of numerous models and software tools to support the practice of design, but, despite the efforts, the diffusion among teachers remain limited.

This thesis relates to the LD research field and the development of teachers' competencies and professionalism. The main objective is to address the problem of understanding and dissemination of LD between teachers non-specialist in design, developing solutions that can facilitate the design process, promoting the sharing of educational designs and the professional development of teachers. Inspired by the approach suggested by the Educational Design Research, the research was carried out in collaboration with a group of teachers of Italian as a second/foreign language from different countries. Collaborating at a distance via a web site developed for the project, teachers were actively involved through semio-participatory design practices which allowed a greater understanding of the use, the expectations and the meaning they attribute to the design in education.

The main results of this research are the definition of a LD approach based on the epistemology of practice and the implementation of LEDITA tool (LEarning Design for ITAlian language), a web application for creating, editing, sharing and reuse of designs. The design process proposed with LEDITA activates a double loop of reflection. The first, during the design phase, allows the development of competences and professional growth through the reflection-in-action and the expansion of the didactic repertoire. The second, through the sharing and adaptation of a design to a new context, the reflection-on-action and the critical review of teachers' professionalism. Finally, these results were validated by exploratory analysis that revealed a good level of usability and understanding by teachers non-specialized in design.

Riassunto

Il crescente utilizzo delle tecnologie in educazione e il mancato raggiungimento dei risultati attesi hanno portato l'attenzione sulla progettazione didattica al fine di favorire risultati educativi migliori e un più proficuo uso delle tecnologie. La progettazione didattica è un'attività complessa che richiede un cospicuo numero di competenze. Negli ultimi anni le ricerche del settore hanno portato allo sviluppo di numerosi modelli e software per supportare la pratica di design, ma, nonostante gli sforzi, la diffusione tra i docenti risulta limitata.

Questa tesi di ricerca si inserisce nel campo del Learning Design (LD) e dello sviluppo di competenze e professionalità dei docenti. Obiettivo principale è affrontare il problema della comprensione e della diffusione del LD tra i docenti non specialisti in progettazione didattica e di sviluppare delle soluzioni che possano facilitare il processo di progettazione e promuovere lo scambio di progetti didattici e lo sviluppo professionale dei docenti. Ispirandosi all'approccio suggerito dall'Educational Design Research, la ricerca è stata svolta in collaborazione con un gruppo di docenti d'italiano come lingua seconda/straniera provenienti da diversi paesi. Collaborando a distanza tramite un sito web sviluppato per il progetto, i docenti hanno partecipato attivamente attraverso pratiche di progettazione semio-partecipative che hanno permesso una maggior comprensione dell'uso, delle aspettative e del significato da loro attribuito alla progettazione didattica.

I principali risultati di questo percorso di ricerca sono scaturiti nella definizione di un approccio alla progettazione didattica basato sull'epistemologia della pratica e alla implementazione di LEDITA (LEarning Design for ITAlian language), una web application per la creazione, la modifica, la condivisione e il riuso di progetti. Il processo di progettazione proposto con LEDITA attiva un doppio ciclo di riflessione. Il primo, durante la fase di design, permette lo sviluppo di competenze e la crescita professionale tramite la riflessione-in-azione e l'ampliamento del repertorio didattico. Il secondo, per mezzo della condivisione e dell'adattamento di un progetto a un nuovo contesto, favorisce la riflessione-sull'azione e la revisione critica della professionalità docente. Tali risultati sono, infine, stati validati da analisi esploratorie che hanno rivelato buoni livelli di usabilità e di comprensione da parte di docenti non specializzati in design.

Resumo

O crescente uso das tecnologias na educação e a falta de alcanço dos resultados esperados levaram a atenção sobre o planejamento didático com o objetivo de favorecer resultados educativos melhores e um uso mais proveitoso das tecnologias. O planejamento didático é uma atividade complexa que requer um alto número de competências. Nos últimos anos, as pesquisas do setor levaram a um desenvolvimento de numerosos modelos e ferramentas para auxiliar a prática do design, mas, apesar dos esforços, a difusão entre os professores permanece limitada.

Esta tese se insere no campo de pesquisa do Learning Design (LD) e do desenvolvimento de competências e profissionalismo dos professores. O objetivo principal é enfrentar o problema da compreensão e da difusão do LD entre os professores não especializados no planejamento didático e no desenvolvimento de soluções que possam facilitar o processo de design e promover o compartilhamento de planos didáticos e do desenvolvimento profissional dos professores. Inspirando-se à abordagem sugerida pela Educational Design Research, a pesquisa foi desenvolvida em colaboração com um grupo de professores de Italiano como língua segunda/estrangeira de vários países, colaborando a distância por meio de um website desenvolvido para o projeto, os professores participaram ativamente através de práticas de design semio-participativas, que permitiram um maior entendimento do uso, das expectativas e do significado por eles atribuídos ao planejamento didático.

Os principais resultados deste percurso de pesquisa são a definição de uma abordagem ao planejamento didático baseado na epistemologia da prática e a implementação do LEDITA (LEarning Design for ITAlian language), uma aplicação web para a criação, a edição, o compartilhamento e o reúso de designs. O processo de design proposto com LEDITA ativa um duplo ciclo de reflexão. O primeiro, durante a fase de design, permite o desenvolvimento de competências e o crescimento profissional por meio da reflexão-na-ação e da ampliação do repertorio didático. O segundo, por meio do compartilhamento e da adaptação de um design a um novo contexto, permite a reflexão-sobre-a-ação e a revisão crítica do profissionalismo dos professores. Estes resultados foram por fim validados através de análises exploratórias que revelaram bons níveis de usabilidade e de compreensão por parte de professores não especializados em design.

To Maria Eduarda, who is blossomed together with this thesis.

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Finally, and most importantly, I would like to thank my wife Isabella. Your faith in me, support, encouragement, quiet patience and unwavering love were undeniably the bedrock upon which the past seven years of my life have been built.

List of Abbreviations

C	interparticipant Consistency
$CADMOS$	CoursewAre Development Methodology for Open instructional Systems
$CLFP$	Collaborative Learning Flow Pattern
$COLLAGE$	COLlaborative LeArning desiGn Editor
$CSCL$	Computer-Supported Collaborative Learning
$CSUQ$	Computer System Usability Questionnaire
D	mean priority Deviation
DAR	Design-Action-Reflection
$DAR3T$	Design-Action-Reflection with 3 Technology concepts
EDR	Educational Design Research
EML	Educational Modeling Language
GC	Global Consensus
GEM	Group Elicitation Method
GML	Graphic Modeling Language
HCI	Human-Computer Interaction
HE	Heuristic Evaluation
$IMS-LD$	Instructional Management Systems - Learning Design
$InterHAD$	Human-Digital Artifact Interaction
$LAMS$	Learning Activity Management System
LD	Learning Design
$LEDITA$	LEarning Design for ITAlian language
$MEASUR$	Methods for Eliciting, Analyzing and Specifying Users' Requirements
MP	Mean Priority
OS	Organizational Semiotics
PAM	Problems Articulation Method
$RELOAD$	Reusable eLearning Object Authoring and Delivery
TEL	Technology Enhanced Learning
UI	User Interface

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Chapter 1

Introduction

In recent decades, the definition of our age in terms of learning society has become popular and, with it, the figure of teacher has although changed, going from professorial and knowledge holder to facilitator and mediator between learners and their available contents [1]. The learning society is characterized by the access to information and by the presence of numerous media, which offer learners and teachers the opportunity to communicate, collaborate, and manage information. The availability of content and ease of communication open up the horizon to a networked society [2], in which the exchange, interaction and comparison are essential for the training and human development.

In this scenario, technologies play an important role, not only for the opportunities, but also to influence the development of new generations, becoming part of our lives and, inevitably, of the practices of teaching and learning [3]. Educational technologies represent therefore a major challenge to adapt educational experiences to technological and social developments. However, even though efforts and resource investments have been significant in last years, results are slow to arrive.

Educational policies have in fact called for an increasing use of technology in the classroom, but it does not seem to have had a great impact in the teaching practice [4]. Cuban [5] argues that even though technologies change, the lack of use seems to derive mainly from the same difficulties. To ensure that technologies can be used profitably, it is needed to develop new competencies and new digital literacy skills [6]. Teachers are expected, therefore, to develop a rich professional competence, composed by a set of knowledge, skills and attitudes needed to address educational events [7].

However, reflection on teacher's professionalism cannot ignore the more general question about knowledge definition and, more particularly, that about pedagogical knowledge. These reflections are, nevertheless, relocated to a meaning horizon in which the pertinent knowledge is that able to locate any information in its context and, if possible, in the whole in which it is inscribed [8]. This ecological approach to the knowledge requires the

presence of teachers able to analyze their own practices, to account for their decisions, to develop personal strategies and modeling, and to design educational intervention useful in different situations, maintaining a continuous relationship with both learners and cultural contents.

Initially, the support to the educational design practice was faced by the Instructional Design, with the definition of specific design approaches and methods [9, 10, 11, 12]. Lately, at the end of the 90's, the Learning Design research field arose, focusing on the development of tools, design methods and approaches to help teachers design and sharing pedagogically effective learning activities. The Learning Design aims to rethink the instructional approach with design models that emphasize the role of the student, through the shift to the process of the design and with a learner-centered focus [13].

Regarding the teachers, the design of educational interventions can be very important to organize a teaching repertoire provided with specific skills, useful to deal with the possible problems that occur in the classroom [14]. However, Learning Design is not a simple practice, but involves a wide set of knowledge, skills and competencies, including: learning theory and its applications, course design principles and procedures, and use of different media and technologies.

Research in this field has attempted to address these issues and to develop useful tools for teaching and learning practices. However, despite these efforts, the research results seem still far from the practice of teachers and proposed solutions suffer from a limited diffusion and a lack of evidence about their effectiveness.

1.1 Research Questions

The main question that motivated this research is:
based on the actual teaching practice and in the horizon of the networked society, which approaches, methods and tools can encourage the design and sharing of educational experiences and promote the development of the necessary competences for the professional growth of teachers?

This question, as the verbs 'encourage' and 'promote' highlight, seems to focus on a problem of attractiveness: the professional growth of teachers depends on the use of LD, but the use of LD is not widespread among teachers, since they probably don't see enough benefits in its use. The attractiveness, therefore, firstly concerns aspects related to the ease of use, efficiency and economy of LD methods and tools.

Nevertheless, the question about attractiveness could conceal a problem of effectiveness. If the language, the metaphor and the representation used by LD are not related to teachers' experience and understanding, the problem is more profound and requires a

complete investigation about the entire conception and structure of LD.

From this point of view, it would seem, therefore, that the technological and pedagogical perspective adopted by the LD stays away from the practice of teachers, limiting the possibility to offer effective solutions for teaching and learning.

For this reason, we have made reference to the methods and practices related to the field of Human-Computer Interaction research in order to focus on usability and meaning of LD for teachers.

Specifically, the questions we posed were:

- How to represent LD in a simple and understandable manner for teachers that are non-specialized in design?
- What level of granularity should LD address?
- How to integrate a specific and detailed representation of educational activities with the possibility to reuse a design?
- How to promote design sharing among teachers?
- What characteristics and mode of interaction should a graphical user interface have to simplify the process of design?
- Does the simplification of the design process allow greater ease of use and dissemination of LD by teachers non-specialized in LD?
- Could the use of a LD software tool allow teachers developing professional competencies and reflecting on their teaching practices?

1.2 Method and Objective

The approach adopted for this research is inspired by the Design-Based Research paradigm [15, 16, 17, 18], and, in order to promote the participation and collaboration of teachers, on the interpretation proposed by McKenney and Reeves [19] called Educational Design Research (EDR). This approach can be defined as a kind of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields theoretical understanding that can inform the work of others.

The relevance of EDR has to do with its connection to practical applications, in which scientific understanding is used to frame not only the research, but also (alongside craft wisdom and creative inspiration) to shape the design of a solution to a real problem. Research is conducted – to varying degrees – in collaboration with teachers, not solely for or

on practice; in this way, solutions to examined problems are developed through successive cycles of analysis, design and evaluation. Figure 1.1 shows the implementation and spread model proposed by EDR, through iterative cycles of analysis and exploration, design and construction and evaluation and reflection, aimed to produce theoretical understanding and practical interventions.

For this thesis, the collaboration with the practitioners occurred through the creation

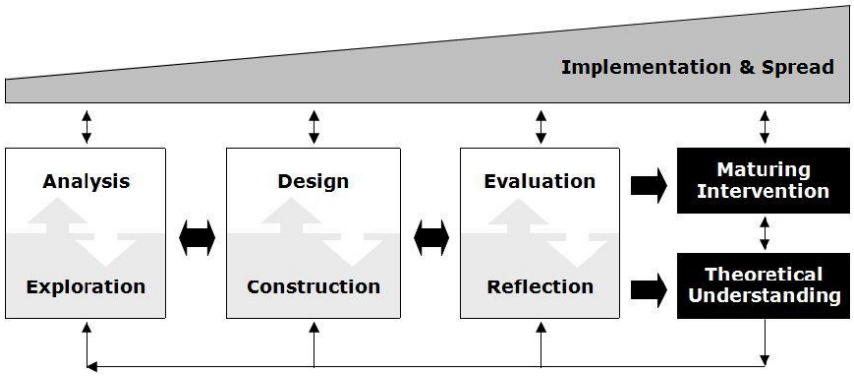

Figure 1.1: Generic model for conducting design research in education (from [19])

of the LEDITA (Learning Design for ITAlian language) project[1] that involved the participation of about 90 teachers of Italian as second/foreign language from 16 countries. In this regard, we developed a web portal through which teachers have actively participated in a number of participatory design practices, contributing significantly to the understanding and further development of research questions and solutions. Figure 1.2 shows the map of participants in the LEDITA project website.

In this specific instance of LEDITA, the final research goals are to address the problem of LD understanding and dissemination by teachers of Italian as a second/foreign language and to develop and test, in collaboration with them, a LD system useful for teaching practice. These objectives, from theoretical and practical perspectives, aim to define a LD process and implement such approach in a software solution.

For this purpose, we adopted the Semio-Participatory Approach [20] that, inspired by Organizational Semiotics [21], integrates the system design with social and participatory practices: the technical level of technology design (the software system) presupposes knowledge of formal (forms and rules) and informal (meanings, intentions, beliefs, responsibilities) social levels, understood by the analysis of signs carried by messages of participatory practices.

Figure 1.3 represents the semiotic onion composed by the three levels of informal, formal and technical information systems through which the design cycle acts with the daily

[1] http://www.professoreitaliano.com

Figure 1.2: Map of participants from the LEDITA research website.

life domain analysis, the norms and laws semantic analysis and the artifacts and systems prototypes [22].

Following these coordinates, the LEDITA research was organized in three phases.

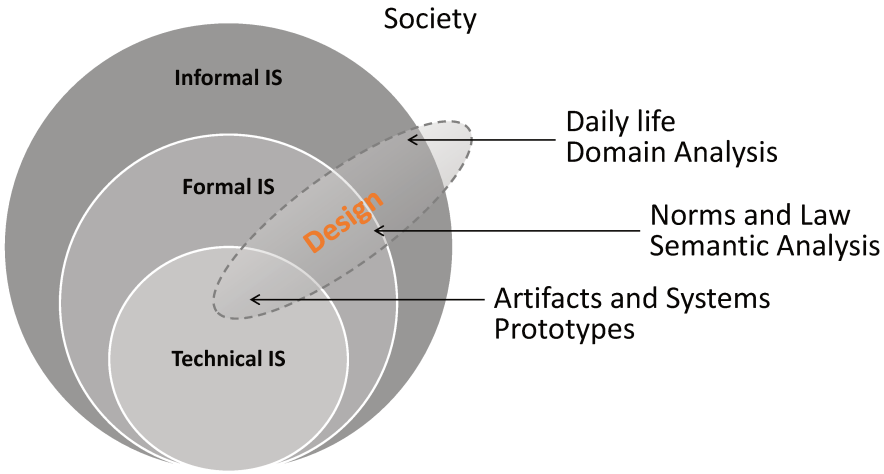

Figure 1.3: Semiotic Onion from [22].

First research phase was represented by a micro-cycle of problem analysis and exploration, approached through a literature review, an analysis of existing LD software tools and an exploration of the meaning that teachers attributed to the practice of design. The

results of these investigations have fostered the definition of a cyclic design model based on the epistemology of practice. These activities are presented in Chapters 2 and 3.

After this first phase, a meso-cycle consisting of two micro-cycles started: the former was characterized by the specification of user requirements, the definition of a LD model and the design and building of a LD software tool; the latter was characterized by the evaluation and reflection on designed solutions through usability explorations and teachers feedback analysis. These activities were conducted iteratively and results are presented in Chapters 4, 5 and 6. Figure 1.4 shows the structure of the research and the related chapters that compose this thesis.

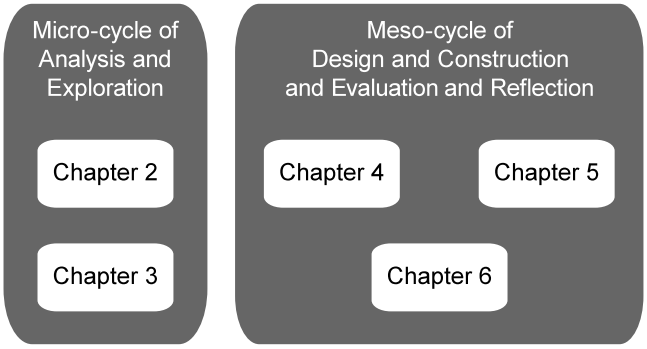

Figure 1.4: Structure of Research Cycle and Chapters.

1.3 Outline of the Thesis

This thesis is organized as a set of articles. With exception of this introduction and Chapter 7, all chapters have been published or submitted to publication. Chapters 2, 3 and 6 have been presented at scientific conferences and published in the respective proceedings. Chapter 4 has been accepted to international conferences. Chapter 5 has been submitted to an international journal.

Chapter 2 was inspired by an extensive review of the literature and from the observation of the gap between the expected results and the effective dissemination and use of Learning Design among teachers. In order to test the hypothesis that this gap stemmed from an extreme complexity of representation and use of existing Learning Design software tools, it has been conducted a Heuristic Evaluation of the usability of two latest generation tools. The results showed the presence of serious usability problems and allowed the identification of five general guidelines for the development of LD software with a better level of usability by teachers not specialized in Learning Design.

The main contribution of this Chapter is the highlighting that more attention to HCI principles and their application in the complex scenario of designing in education is needed to design and develop effective Learning Design software tools.

Chapter 2 has been published as:
A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Making Design Easy: a Usability Evaluation of Latest Generation Learning Design Tools," in *World Conference on Educational Multimedia, Hypermedia and Telecommunications (EDMEDIA)*, J. Herrington, A. Couros, and V. Irvine, Eds. Victoria, Canada: AACE, 2013, pp. 960–965.

Chapter 3 arose from the request for greater attention to usability aspects emerged in the previous Chapter, leading the focus of the research on the real teaching practice. In this manner, the needs, characteristics and values of end-users can be considered in the development of new solutions, useful for the dissemination of LD. The relationship between the teachers' practice and the LD have therefore been investigated through a review of the literature and a study conducted by means of semi-structured interview to the teachers collaborating with the research project. The results obtained showed a rich scenario, from which it was possible to highlight not only the importance of the technical aspects related to LD, but also the central role that it occupies in the development of competences and in the professional growth of teachers.

The main contribution of this Chapter is the definition of an iterative design model based on the Schön's epistemology of practice [23], composed by a cycle of (re)design, action and reflection. Furthermore, another important point is the highlighting of the most important elements for the development of solutions to the LD that were sufficiently flexible to adapt to the complex educational scenario and probably close to the language and educational practice of teachers.

Chapter 3 has been published as:
A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Learning Design and Teaching Practice: Outlining an Iterative Cycle for Professional Teachers,"in *2013 IEEE 13th International Conference on Advanced Learning Technologies (ICALT)*, Beijing, China: IEEE, 2013, pp.280,284.

Chapter 4 investigates the relations between teaching practice and LD by conducting semio-participatory practices [24] with a group of teachers at a distance. The objective of this study was to understand the meaning that teachers make to issues regarding le-

arning design practices and representations, aiming at eliciting user requirements for a prospective LD software tool. Results have allowed synthesizing a number of requirements elicited from contextualized and well-discussed information.

The main contribution of this Chapter is the elicitation of aspects of the professional world of potential end-users, with their needs and expectations. Furthermore, it was possible to synthesize a number of practical indications useful for developers interested in development informed by the practice of the main interested parties.

Chapter 4 has been accepted to the Ninth European Conference on Technology Enhanced Learning (EC-TEL 2014).
A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Eliciting Requirements for Learning Design Tools: a Semio-Participatory Approach", unpublished.

Chapter 5 investigates the role of the design in the educational context, aiming to define a LD approach useful to promote the professional development of teachers and the sharing of knowledge between novices and experts. The results of previous research studies were synthesized in a detailed framework for the creation, the orchestration and the reuse of designs among a community of teachers. Reaffirming the usability importance for the dissemination and reuse of design in education, an exploratory analysis of usability was conducted through an informal test with 6 members of the InterHAD (Human-Digital Artefact Interaction) research group at the Institute of Computing in the University of Campinas (UNICAMP)[2]. The results have shown a good level of usability, opening the perspective for the implementation of the LEDITA approach in a software tool.

The main contribution of this Chapter is the connection of the cycle of design, action and reflection proposed in Chapter 3 with a design approach developed through a process of recursive reflection-in-action and reflection-on-action, which allows designing and reusing educational activities in dialogue with a specific context.

Chapter 5 was submitted to an international journal.
A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Learning Design for Reflective Teachers: the LEDITA Approach to Professional Growth", unpublished.

Chapter 6 presents the LEDITA tool, a LD editor developed within the LEDITA participatory research project for the representation and sharing of designs between a

[2]http://styx.nied.unicamp.br:8080/interhad

community of teachers of Italian as a second/foreign language. A usability test was conducted with the objective to take a holistic look at the LEDITA system and gathering data concerning the process of creation of a learning design and the effectiveness of the LEDITA tool. Results from the study showed a good usability level and a consistent support to the reflection on teaching practice, especially in relation to the organization and management of knowledge and content.

The main contribution of this Chapter is to highlight the possibility to overtake the perceived incompatibility between the support of design sharing and the encouragement of teaching reflection, by means of a participatory development process that connected educators and programmers in a flexible and tailored solution.

Chapter 6 has been published as:
A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Grounding Learning Design on Teaching Practice: the LEDITA Learning Design tool for Italian Language Teachers", in *2014 IEEE 14h International Conference on Advanced Learning Technologies (ICALT)*, Athens, Greece: IEEE, 2014, pp.706,710.

Chapter 7 illustrates the conclusions and future works.

Figure 1.5 illustrates the research outline of core chapters with the details of the participants (with blue or green background), the research activities (with blue border), the working phases (with gray backgroun), the main contributions (with green borders) and the evaluation activities (with red borders).

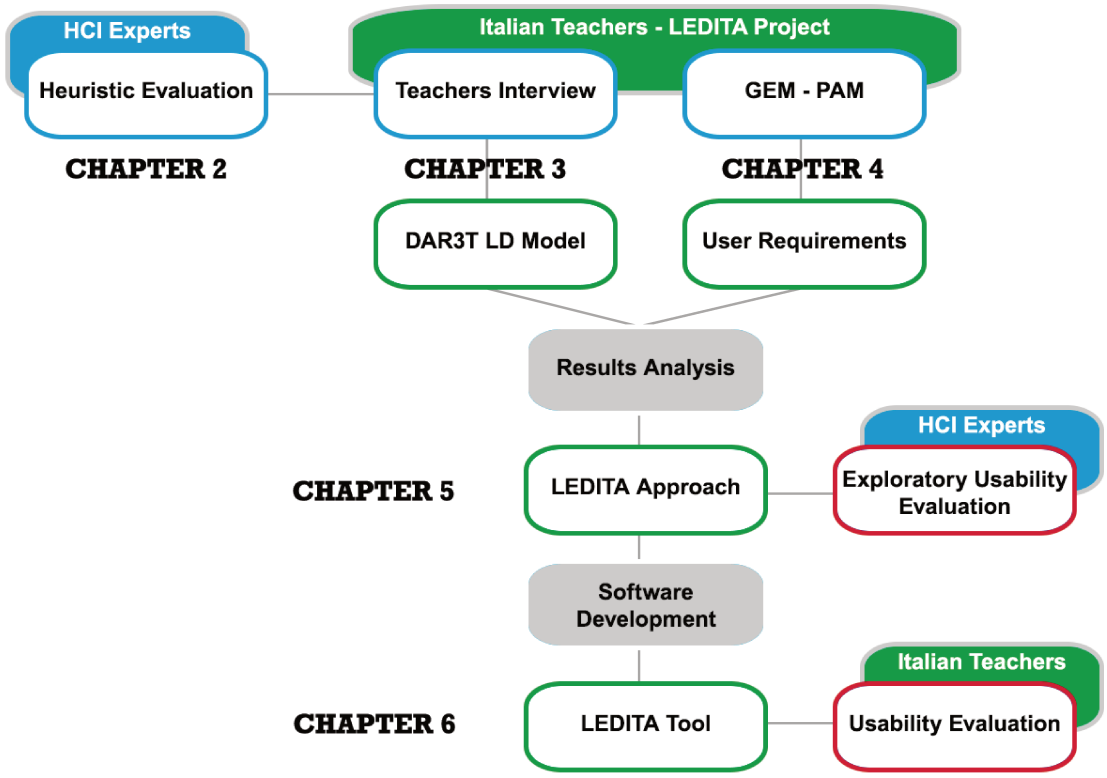

Figure 1.5: Research Outline.

Chapter 2

Making Design Easy: a Usability Evaluation of Latest Generation Learning Design Tools[1]

2.1 Introduction

In last years, technology has revolutionized many areas, but even though efforts and resource investments have been significant, educational results are slow to arrive and from many sides there is a strong demand for more attention to theoretical aspects and to reflection related to its use in the educational field [25]. In fact, most of researches deal with case studies, examples of application of new technologies, development of new tools, but few deepen relationships and necessary knowledge to integrate technology and education. The uncritical and instrumental use of technology is therefore limiting and ineffective if not accompanied by a full integration with the content knowledge and pedagogy [26]. In order to support the integration of technology, content and pedagogy, to promote a more explicit reflection about these knowledge and to support the exchange of information, Learning Design is a key factor which, if made accessible and usable in large-scale by teachers, can bring significant benefits to their communities.

The research field relative to Learning Design has risen in the past decade to respond to the problem of the gap between the potential offered by technologies and their effective use in the educational practice. The term Learning Design appeared in the technical community and began to gain prominence around 2004, following the development of the

[1] A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Making Design Easy: a Usability Evaluation of Latest Generation Learning Design Tools," in *World Conference on Educational Multimedia, Hypermedia and Telecommunications (EDMEDIA)*, J. Herrington, A. Couros, and V. Irvine, Eds. Victoria, Canada: AACE, 2013, pp. 960–965.

'Educational Modeling Language' (EML) at the Open University of the Netherlands and, from this, the specification IMS Learning Design (IMS LD) [27]. To date, the state of research in this area can be considered in the emergence stage [28] and, within the research community, there is not yet a shared vocabulary. The field itself is called "learning design"[29], "instructional design"[30], "curriculum design"[31], "educational design"[32], "design for learning"[33] and "design-based learning"[34].

The diffusion of Learning Design among teachers still remains very limited and it has been felt the need for further researches in the documentation of practices carried out by teachers [35] and in the development of a language and tools that provide support to Learning Design in a flexible, understandable and easily accessible way [36, 37]. In recent years, many efforts have been made to develop more efficient representation languages and tools and to promote the diffusion of Learning Design among teachers. IMS LD, which has three levels of implementation available (1. the level A that contains all the core vocabulary needed to support pedagogical diversity, 2. the level B that adds Properties and Conditions to level A, 3. the level C that adds Notification to level B), remains a reference point for the formalization of the artifacts but latest generation tools, although almost always create an IMS LD compliant design, have followed a trend away from the metaphor used by IMS LD in favor of representations that facilitates interpretation and understanding.

This work aims at situating the concept of Learning Design and contemporary tools to support it, analyzing their usability aspects. The text is organized as follows: the next section presents the concept and main tools to support Learning Design activities (2.2); then the usability study is presented (2.3), followed by the results (2.4) and by the discussion and further work suggested in the field (2.5).

2.2 Learning Design and Learning Design Tools

Conole [38] defines Learning Design as a "methodology for enabling teachers/designers to make more informed decisions in how they go about designing learning activities and interventions, which is pedagogically informed and makes effective use of appropriate resources and technologies. This includes the design of resources and individual learning activities right up to curriculum-level design. A key principle is to help make the design process more explicit and shareable. Learning design as an area of research and development includes both gathering empirical evidence to understand the design process, as well as the development of a range of learning design resources, tools and activities". Learning Design can be considered both as a process of educational experiences design (written with a capital letter), and as a product (written in lowercase), i.e. as an artifact

resulting from the design process [39]. In the first case, the emphasis is placed on the phase of Learning Design creation and on the processes useful to favor it; in the second, the aspects concerning the possibility of storing and exchanging the produced artifacts are highlighted.

Among last generation Learning Design software tools, there are: 1) CADMOS (CoursewAre Development Methodology for Open instructional Systems) [40] – is a graphical editor that intends to allow educational practitioners to build, revise and visualize the desired learning designs, without the need of technical skills. The creation of a learning design is divided into three phases: 1. The definition of metadata, 2. The creation of the conceptual level, with the definition of activities, actors and resources, and 3. The specification of the flow model with the organization of the activities and the specification of the navigation rules. CADMOS is integrated with Moodle and allows to export an IMS LD level A and B compliant design; 2) COLLAGE (COLlaborative LeArning desiGn Editor) [41] – is a graphic-based Learning Design authoring tool for computer supported collaborative learning (CSCL) environments. It is integrated in RELOAD (Reusable eLearning Object Authoring and Delivery) [42], an IMS-LD full compliant Learning Design editor, which provides a plug-in framework, and it is IMS LD level A compliant. The creation of a learning design is a process of particularizing and adapting a collaborative learning flow pattern (CLFP), selected in a provided repository, according to the requirements of a particular learning situation; 3) CompendiumLD [43] – is a visual tool that adds a set of specific learning design icons and tools to the Compendium Tool [44]. It does not produce an IMS LD compliant design and its aim is to make the design process more explicit and to promote the share and reuse of learning designs by making available a repository of shared designs; 4) OpenGLM (Open Graphical Learning Modeler) [45] – based on GLM, OpenGLM is an authoring tool aimed to support the building of a community of practice around standards-based instructional models. OpenGLM is connected to a repository of open educational resources and produce IMS LD Level A and B compliant designs; 5) ReCourse [46] - is a visual editor designed as a successor to the RELOAD. To support users in their engagement with IMS LD, usability improvements were developed including a simplified authoring interface, access to repositories and a general reinterpretation of the IMS LD metaphor, hiding the tree structure in favor of a freer spatial organization, allowing to change the terms indicated in the specification (e.g. play can be set to course) and simplifying where possible the concepts of the specification (e.g. role part is inferred from a relationship between a role and an activity) . ReCourse is an IMS LD Level A, B and C compliant.

These software tools intend to provide a simple interpretation of Learning Design and to support the diffusion of Learning Design (process and product) among teachers, through a focus on interaction and on a better development of their user interfaces. Thus,

next section presents an exploratory investigation of usability aspects of two of those Learning Design tools.

2.3 The Study

The study is part of the Ledita (Learning Design for Italian Language) research project [47] and consisted in a heuristic evaluation of two Learning Design tools developed to be used by teachers and practitioners non-specialized in Learning Design: CompendiumLD and CADMOS. These two tools have been chosen for their declared inclination to represent the process of learning design in a general way, not necessarily corresponding to the IMS LD specification, and for the interest to draw on a large audience.

The aim of the Heuristic Evaluation (HE) [48] is to identify usability problems in a user interface (UI) design by experts' examination of the UI, who judges the compliance of the interface with recognized usability principles. Nielsen identified 10 principles, the heuristics, which represent rules of thumb for an effective user interface design: 1) Visibility of system status, 2) Match between system and the real world, 3) User control and freedom, 4) Consistency and standards, 5) Error prevention, 6) Recognition rather than recall, 7) Flexibility and efficiency of use, 8) Aesthetic and minimalist design, 9) Help users recognize, diagnose, and recover from errors, 10) Help and documentation. In respect of each heuristic, the examiner finds the related problems and assign to each one a severity rating in a 0 – 4 scale, based on the frequency, the impact and the persistence of the problem: 0 = I don't agree that this is a usability problem at all, 1 = Cosmetic problem: need not be fixed unless extra time is available on project, 2 = Minor usability problem: fixing this should be given low priority, 3 = Major usability problem: important to fix, so should be given high priority, 4 = Usability catastrophe: imperative to fix this before product can be released.

The data were collected in a two hours session during the 2012 "Design of User Interfaces" course offered at the State University of Campinas. The participants were 26 graduate students in computing (Master and PhD), with a background in computer science and no previous experiences with Learning Design nor with the evaluated tools. Participants were divided into two groups of 13 students and each group evaluated only one tool, using a form based on Nielsen's heuristics. Before performing the evaluation, participants received a document with: a) a definition of Learning Design, b) a brief presentation of CompendiumLD and CADMOS, c) an end users analysis that characterized the users as teachers with a good relation with technologies and no formal experience with Learning Design, d) a use case composed by a textual learning design of an Italian language lesson that participants had to represent using one of the evaluated software. The learning design to be represented was composed by a metadata section (title, context

and information about students, prerequisites, learning goals, duration, and additional resources), and 4 activities (3 simple and 1 composed by 2 simple activities) with details for every step about timing, resources and actors. The complexity level of the learning design corresponded to the IMS-LD Level A and was adequate to test some common tasks that users would do: add activities, actors, resources and organize them in a time structured unity of learning. To highlight all the important parts for the representation of the learning design, we asked the examiners to pay special attention to two components: the representation of all the elements in the learning design (actors, resources, activities, etc.) and the organization of the activities flow (the order of the various phases, the time, etc.).

2.4 Findings

The participants' evaluations highlighted a total of 245 problems, of which 117 related to CADMOS and 128 to CompendiumLD. In analyzing the results we have proceeded to unify similar problems, obtaining a total of 118 consolidated problems, 55 relative to CADMOS and 63 to CompendiumLD. For CADMOS, the minimum number of problems identified by a participant was 4, while the maximum number was 19; for CompendiumLD, the minimum number was 4 and the maximum 15. For this experiment, the largest number of evaluators compared to the number recommended by Nielsen (from 3 to 5) has allowed the identification of a higher number of problems and to fill possible shortcomings due to lack of experience of some evaluators.

The severity rating evaluation of problems was fairly consistent among the participants, since only 9 cases (out of 55) for CADMOS and 4 cases (out of 63) for CompendiumLD have received a different, although not so discordant, evaluation and indicates the presence of important problems. Concerning the heuristics, problems were detected for each of them and the difference in the most problematic heuristics reflects the different design characteristics of each tool. Tables 2.1 and 2.2 show the details regarding each heuristic for each evaluated system.

To deepen the qualitative analysis based on the evaluators' explanations reported, we can notice that most of the problems reported concern: 1) usability and system functions (e.g. "The software is not intuitive and presents difficulties in the handling", "Putting two activities with the same name causes a catastrophe and the loss of everything that was done in that activity."); 2) navigation (e.g. "Breaks in layout standards confuse navigation", "Information missing, to determine the path of the link before the click", "There are instances where the program does not allow return to previous step"); 3) icons and metaphors used (e.g. "Icons do not follow a standard easily identifiable", "Difficulty in identifying function of icons", "Some navigation elements do not appear as such"); 4)

Table 2.1: CADMOS Usability Problems

Heuristics	**Severity Ratings 1 = Cosmetic, 2 = Minor, 3 = Major, 4 = Catastrophic**					**Problems per Heuristic**
	1	2	3	4	Multiple	
1. Visibility of system status		1	3		1 (1/3)	5
2. Match between system and the real world		2	1	2	3 (3/4, 2/3, 2/3)	8
3. User control and freedom	1		1	1	1 (2/3, 2/3)	5
4. Consistency and standards	1	1	1			3
5. Error prevention		3	3	2	1 (2/3)	9
6. Recognition rather than recall		1	3	1		5
7. Flexibility and efficiency of use	2	1	3	3		9
8. Aesthetic and minimalist design			5		1 (2/3)	6
9. Help users recognize, diagnose, and recover from errors		1	1	1	1 (2/3)	4
10. Help and documentation	1					1
Total Problems per Severity	5	10	21	10	9	**55**

Table 2.2: CompendiumLD Usability Problems

Heuristics	**Severity Ratings 1 = Cosmetic, 2 = Minor, 3 = Major, 4 = Catastrophic**					**Problems per Heuristic**
	1	2	3	4	Multiple	
1. Visibility of system status	2	1	4			7
2. Match between system and the real world	1	1	3		1 (2/4)	6
3. User control and freedom	2	1	3	2	1 (1/2/3)	9
4. Consistency and standards		3	2	4		9
5. Error prevention	2	1	2	2		7
6. Recognition rather than recall			2		1 (1/3)	3
7. Flexibility and efficiency of use			3		1 (2/3)	4
8. Aesthetic and minimalist design		5				5
9. Help users recognize, diagnose, and recover from errors			5	1		6
10. Help and documentation	1		3	3		7
Total Problems per Severity	8	12	27	12	4	**63**

conformity to standards (e.g. “Attempting to delete an activity by dragging it in the trash was unsuccessful”, “The universal shortcut CTRL+z doesn’t work”); 5) feedback (e.g. “Required fields are not indicated, but when you try to move on without filling them, an error screen appears”, “Lack of defaults and help messages make difficult to fill in some fields”); 6) accessibility (e.g. “The actions need to be performed exclusively with the mouse”, “There aren’t shortcut keys.”); 7) errors prevention (e.g. “Errors cannot be recovered because there is no undo function”, “The system has not a control on user inputs. You can enter information without validations”); 8) help and documentation (e.g. “passing the mouse over the icons there is no tip describing the tool item”, “There is no

help for filling the fields"); 9) personalization (e.g. "Do not allow the user to customize frequent actions.", "The resource type is already defined between a limited number of possibilities and it is not possible to add a different type of resource"); 10) information access (e.g. "In activities and in resources there is no way to view information about the properties, actors, etc.", "The system allows to close tool windows, but is not easy to find them again"); 11) memorization (e.g. "Need to remember configuration values of the home screen", "there is no indication of the layer tree that was formed, indicating which is the root level and the others").

From textual analysis of the problems described in the evaluation forms, we observe that for CADMOS (Fig. 2.1) the words most frequently used are related to the organization of information and to the particular management of the process divided into two layers, while for CompendiumLD (Fig. 2.2) the most frequent words relate to the metaphor used, the stability of the system and the demand for a greater attention to the user.

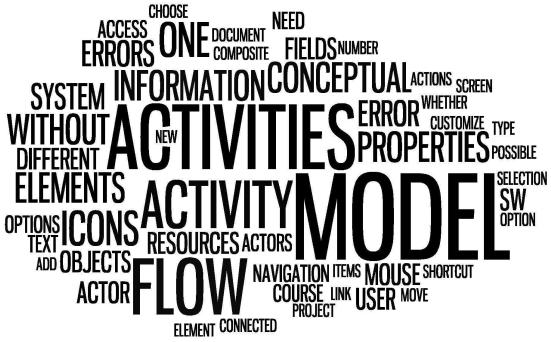

Figure 2.1: 50 Most Frequent Words in CADMOS Problems

Figure 2.2: 50 Most Frequent Words in CompendiumLD Problems

2.5 Discussion and Conclusion

The attention to human-computer interaction aspects during software development is essential to obtain satisfactory results that meet end user needs. The results of the heuristic evaluation obtained from the study highlighted that, even the latest generation software for Learning Design, report significant usability problems related to all aspects of use. The presence of a considerable number of major and catastrophic problems indicates that it is necessary to devote much more attention to usability and accessibility aspects to ensure that such software can have a greater impact among teachers and practitioners who are not specialists in Learning Design or in software systems technology.

In order to make the Learning Design software smoother to use, the results suggest focusing on five main guidelines: 1) greater respect for currently recognized standards in software development and user interaction; 2) more accurate choice of metaphors and languages used which could allow an easier identification, interpretation and meaning making by the end user; 3) more efficient organization of the information to facilitate an improved access to system functionalities and navigation; 4) attention to the processes and tasks implemented, so that long learning paths and excessive use of memory would not be required; 5) error prevention through the creation of paths supported by localized feedbacks and helps.

To conclude, results of the exploratory study on the usability of Learning Design tools conducted in this work made clear that much more studies are therefore needed that include more attention to HCI principles and their application in the complex scenario of designing and developing software system to support Learning Design technology.

Chapter 3

Learning Design and Teaching Practice: Outlining an Iterative Cycle for Professional Teachers[1]

3.1 Introduction

In recent decades, from numerous socio-cultural changes, attention has been focused on identity and teacher professionalism. New global horizons, the comparison of values and different cultures, the current multiplicity of educational resources and tools available have opened the space for discussions about the teacher's thinking and human and professional characteristics related to him/her.

This scenario of educational research has been remodeled since the sixties by the intuition of Gage [49], which highlights the groundlessness of the assumption holding educational research through the metaphor of the mirror: teaching theory was deduced from learning theory, with an obvious bias, like that of the image reflected on a mirror. By the viewpoint of educational models aimed at the product, the direct linearity between the process (educational intervention) and the product (student learning) was postulated: it was sufficient to know learning mechanisms to carry out an effective educational action, through the control of stimulus and response mechanisms. All this excluded from the pedagogical field the complexity of the interaction between teacher and students, the educational environmental variables and, especially, the teacher's subjectivity.

This model was subsequently queried by Shulman [50] in the late eighties with the definition of "Pedagogical Content Knowledge", the pedagogical knowledge that relates

[1] A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Learning Design and Teaching Practice: Outlining an Iterative Cycle for Professional Teachers," in *2013 IEEE 13th International Conference on Advanced Learning Technologies*. IEEE, Jul. 2013, pp. 280–284.

disciplinary epistemology, context and teacher's specific competencies. It defines the relationship between the various fields by implementing a cognitive process strongly linked to its "thought"about teaching. Teacher cannot remain outside the educational process, since he/she is an essential element of it and, especially, he/she cannot attempt to stifle and to maintain extraneous to the educational activity his/her experiences, his/her beliefs, his/her values and his/her pedagogical principles. It is the emergence of implicit knowledge which he/she enacts during his/her educational activity that can allow redirecting educational research, taking into account the complexity of the interaction between actors and the context of teaching and learning processes.

A further contribution to this debate comes, finally, by Schön [23] with the foundation of an epistemology of practice: by the author, learning and awareness of one's own educational strategy occur with a double-loop composed by "reflection-in-action"and "reflection-on-action": the former, during the action, allows to continually reshape the action with reference to context changes, and the latter, afterwards the action, allows the change of the cognitive map of reference. Error detection and correction lead to revise the cognitive map and to define the professional as a "reflective practitioner", as source of practical knowledge according to an alternative epistemology; to the reflective practitioner, the distinction and the reduction of reality lose value, because he/she is based on the action, on the connection and on the relationship with the ecological context that forms the background of the education complexity itself.

Following this path, the professional is seen as the holder of a specific professional practice: by extensive studies, he/she has acquired experiences and skills necessary to carry out, with autonomy and responsibility, unusually intellectual acts, aimed at achieving certain objectives in complex situations [51].

Professional teacher holds professional knowledge, namely action models that allow him/her to activate his/her knowledge in specific situations, and essential aptitudes to teaching practice (management of his/her own emotions, cooperation disposal, etc.). This knowledge, patterns of actions and aptitudes constitute the professional competencies of expert teachers, competencies that, through their cognitive valence, and affective and conative practices, allow the formation of the articulated and multifaceted profile of professional teacher. These competencies derive from interaction of different knowledge, grouping by two main categories: theoretical knowledge, which includes knowledge to teach and for teaching, and practical knowledge, that includes knowledge about practice (i.e., procedural, on how to do), and on practice (knowing when and where). Practical knowledge sets out a distinction between novice and expert professional teachers.

In this perspective, the peculiar characteristic to a professional teacher is the competence in adaptation to changing and complex context, and his/her ability to control situations, even those new and unexpected, through the outfit of all those instruments

forged by his/her experience and through the reflection on his/her teaching practice.

This paper aims at questioning the relationship between Learning Design and teaching practice and at proposing an epistemology of practice-inspired perspective to promote the diffusion of Learning Design among professional teachers. The text is organized as follows: section 3.2 introduces the concept of Learning Design and its current relation with teaching practice, sections 3.3 and 3.4 present a structured interview conducted with 30 professional Italian language teachers about Learning Design and teaching practice. Section 3.5 discusses the results of the study and highlights the role of Learning Design in teachers' professionalism development. Section 3.6 illustrates the conclusions of the study and future works.

3.2 Learning Design

Conole [52] defines Learning Design as a "methodology for enabling teachers/designers to make more informed decisions on how they go about designing learning activities and interventions, which is pedagogically informed and makes effective use of appropriate resources and technologies. This includes the design of resources and individual learning activities right up to curriculum-level design. A key principle is to help make the design process more explicit and shareable. Learning design as an area of research and development includes both gathering empirical evidence to understand the design process, as well as the development of a range of learning design resources, tools and activities". Learning Design can be considered both as a process of educational experiences design (written with a capital letter), and as a product (written in lowercase), i.e. as an artifact resulting from the design process [53]. In the first case, the emphasis is placed on the phase of Learning Design conception and on the processes that favor it; in the second, the aspects concerning the possibility of storing and exchanging the produced artifacts are highlighted.

Learning Design appeared in the technical community and began to gain prominence around 2004, following the development of the 'Educational Modeling Language' (EML) at the Open University of the Netherlands and, from this, the specification IMS Learning Design (IMS-LD) [27] . The diffusion of Learning Design among teachers still remains very limited and it has been felt the need for further researches in the documentation of practices carried out by teachers [35] and in the development of a language and tools that provide support to Learning Design in a flexible, understandable and easily accessible way [36, 37]. In recent years, many efforts have been made to develop more efficient representation languages and tools and to promote the diffusion of Learning Design among teachers, but results have not yet reached the usability levels required for a wide spread

among teachers [54].

3.3 The Study

The study consisted of a structured interview concerning Learning Design and teaching practice and was part of the Ledita (Learning Design for Italian Language) research project [47], which, following the Educational Based Research methodology [19], aims at developing, in collaboration with a group of Italian language teachers from 16 countries, practical solutions and theoretical knowledge in relation to the Learning Design and the Italian language teaching.

The interview was conducted with a group of 30 teachers, including 7 from Italy, 4 from Argentina, 4 from Brazil, 3 from Portugal and 1 respectively from Costa Rica, France, Germany, Greece, Ireland, Netherlands, Norway, Spain, Switzerland, Turkey, United Kingdom and Vietnam. 27 participants had a tertiary education, of which 3 teachers with doctoral degrees, 10 with Master Degree, 14 with Graduation. 2 teachers had a Diploma and 1 had a technical training. All teachers had a liberal arts education and 11 of them had a multidisciplinary background. The fields of education were modern languages, pedagogy, literature and humanities. The training is fairly recent with 7 teachers who have completed the course less than one year ago, 10 between 1 and 5 years ago, 8 between 5 and 10 years ago and 5 for more than 10 years.

The professional teaching experience of participants was relatively high with 1 teacher with less than 1 year of experience, 5 teachers with less than 5 years of experience, 9 teachers with 5-10 years of experience and 15 teachers with more than 10 years of experience. With regard to workplace, 16 of them taught at a university, 11 in a public organization or association, 7 in a private language school, and 5 in a public school. Among them, 6 participants were teaching in more than one organization. Students of their courses were mainly adults; 8 teachers were teaching to students younger than 18 years, but 6 of them also teaching to adult students.

They were asked how was their relationship with technology and none of them said to have a negative one, whereas 2 said to have a minimum relationship, 21 a good relationship and 7 an excellent relationship. The most commonly used technologies were computer, smartphone and tablet in private life, and computer and interactive whiteboard in professional life. With regard to the software tools, all the participants used Internet, 22 had an e-mail address, 20 used an office suite, 12 a graphics program and 25 a video editing tool.

The interview consisted of 25 questions divided into 5 sections: 1. The Learning Design, to deepen the relationship between the teaching practice and the design, 2. The Design Phase, to examine in detail the procedures used in the design, 3. The Learning

Design Artifact, to describe modalities of development and organization of the design product, 4. Beyond the Design, to explore the longevity of an educational project and the possibility of its re-use, 5. Learning Design and Technology, to deepen relations between Learning Design and the use of technology.

3.4 Findings

3.4.1 The Learning Design

The practice of learning design was a regular activity for 29 of the 30 teachers who claimed to use it constantly in their professional practice. The only negative answer was justified by the demand for the teacher to follow a program of activities already organized in detail by his/her school. The presence of Learning Design seems to be motivated by two main factors: on the one hand by the need to orchestrate and plan in advance activities that will be carried out in the classroom, on the other hand by the desire to reflect and organize their own work, in order to deal consciously with best choices and secure better results.

In detail, none of them said to follow a specific methodology for the design, and the keyword seems to be "flexibility", to adapt programs to students' needs, to contextual variables and to the policies of the schools. Also with regard to the granularity of Learning Design, there was not a unanimous agreement, but two typologies were highlighted: the curriculum design, with a duration of usually one semester, addressed to define the general objectives and the articulation of the educational path at a low level of detail, and the design of each single lesson, which, integrated into the path defined by the curriculum, illustrates with a high level of detail the activities to be carried out for a specific objective in a defined time.

In the conduct of design activities, an important role is played by the time required for its implementation; in fact, if the design of the curriculum for a semester varies from 3 hours to 3 weeks, depending on the level of detail and the format adopted, the design of a single lesson varies from half to three times the effective duration that will have the lesson. A further element of interest is that the curriculum design was normally undertaken in a collaborative way, while the design of a single lesson was carried out individually. However, the 4 teachers who have had experience of collaborative design at a single lesson level have had a very enthusiastic and positive impression.

3.4.2 The Design Phase

Analyzing the details of the various design phases, a heterogeneous reality emerged with large differences characterized by the pedagogical approaches adopted and by the edu-

cational objectives pursued. However, even if teachers did not refer to common design methodologies, some elements emerged in most of the interviews, among which the main one seems to be the definition of specific objectives starting from the analysis of the real context of the students who will perform the activities. Indeed, all teachers have highlighted how the attention to a specific context is a crucial factor for the success of a learning design: some elements mentioned in the definition of the context were the composition of the class, the knowledge level of the discipline, the homogeneity of students' level, the social background and geographical location of the students and the school, the presence of technology in students' lives, the availability of technologies in school, the progress of the curriculum, the prerequisites and the general educative objectives linked to the activity to be designed. Other elements that were highlighted for the design phase were the reference to the used resources, both from textbooks and from digital sources, the attention to the execution time of the planned activities and, finally, the importance of the reflection on the design to be done after its execution in the classroom.

Almost all the teachers have therefore declared to reuse a learning design after its first use, but only after renewing and adapting it to the new context of use. Indeed, students with their educational needs and their skills are the primary actors highlighted by all teachers. Other important stakeholders that have been put in evidence were the organizations in which teachers work and with which they must deal, the other colleagues who will be teaching in the same classes, and especially the learning resources to use that play a central role in teaching. The role of teacher, instead, mainly because of the pedagogical approach prevailing among language teachers, remains in the background and teachers almost always refer to themselves as mediators or facilitators of the learning process.

The elements for which teachers have declared essential to take into account during the design were the management of the time to devote to activities, the students and their specific needs, and finally, the objectives to be achieved. According to all the participants in the interview, problems that arise during Learning Design seem not to belong specifically to the design, but they are didactical problems that emerge from the planning and orchestration of activities.

3.4.3 The Learning Design Artifact

In the practical implementation of Learning Design, all teachers reported to use only generic tools such as pen and paper or a word processor. The representation that they use to describe the learning design is basically textual and only 4 teachers said they eventually use graphs or tables.

The definition and organization of the sections that compose a learning design vary from teacher to teacher, depending on the pedagogical approach used, on the specific aims

and on their teaching style. A common element, however, was the presence of a metadata section related to the definition of the students' context, the educational objectives and the didactical resources to be used during the activity. Interesting to note that, according to most of the participants, the longevity of a learning design is closely linked to its flexibility and to the possibility to be reshaped after its first use.

3.4.4 Beyond the Design

Once represented and used, learning designs were stored by the majority of teachers in computer folders or in a cloud storage service, and a security backup was realized in external archives. The management and conservation of the learning designs seems to be very important, because all teachers have reported that after the use, learning designs are still useful and can be reused, also with the possible update of the related resources or the possible improvements suggested by first use feedbacks.

Finally, in addition to the creation of learning designs, about half of the interviewed teachers said that they use other formal or informal documentation practices, including class registers, blogs, journal articles and video recordings of classroom activities.

3.4.5 Learning Design and Technologies

None of the interviewed teachers knew or had ever used specific software for Learning Design. For the implementation of their projects, they relied on generic software tools or web office applications. As regards the design of educational activities involving technologies, conceived as content or learning tool, the answers were of three types: 1. For 12 teachers who interpreted the technology in a more instrumental way, the design does not change with respect to that of traditional activities, since the pedagogical and didactic basis remain the same, 2. For 2 teachers, the design changes because it is necessary to consider the possibility that electronic devices may not operate properly when needed, and therefore proves necessary to have an alternative emergency plan, 3. For 16 teachers, however, the use of technology significantly changes the design phase because the numerous possibilities offered by technological tools allow to mainly personalize the teaching and to adapt it to the specific needs and learning styles of each student.

All teachers have recognized the usefulness of Learning Design, and several positive aspects were highlighted including: it is a great tool as teaching support, is a good help for novices, helps to organize the timing of activities, the relationships in the classroom and the didactical resources to use, it can be a problems anticipator and facilitate their resolution, and can help provide guidance to students on the path that they face. The negative points noticed, however, are primarily related to the amount of time required for the design and the difficulty to create learning designs flexible enough to be able to be

truly effective and applicable in the real learning context.

The quality evaluation of learning designs is based according to the teachers answers on three main aspects: 1. for 15 teachers it is based on learning outcomes achieved by executing the designed activities, on the aroused motivation, and on positive feedback from students, 2. for 12 teachers on the ability of Learning Design to foster teachers' reflection and the conscious application of pedagogical principles to which they refer, 3. for 3 teachers on the possibility of Learning Design to be re-used again. Finally, a revealing observation was made by a teacher who compared the Learning Design to a gym for teachers, that allows them to prepare for teaching through looking after and organizing every detail and reinforcing their own awareness on what to do, how to do, when to do, with who to do and why to do a learning activity.

3.5 Discussion

The practice of Learning Design involves a wide range of knowledge and refers to a complex scenario in which many skills and competencies are required [55]. In the development of research in recent years, however, the focus of attention has been on the technical aspects of Learning Design support tools and on the possibility of sharing teaching ideas, rather than on the real importance of developing teaching professionalism [56]. The search for a sufficiently flexible formalization to ensure rich expressiveness and pedagogical neutrality has led to a stiffening, difficult to reconcile with the demands of teachers for flexibility and teaching support. We must not forget that the educational field represents a complex scenario in an exemplar mode, difficult to be framed in rigid schemes and predefined modalities of representation, such as that of musical notation [57]. It is not matter, therefore, of discovering a miraculous language that allows to capture unique moments and educational interactions and make them serials and reproducible, but to approach again to the teachers and listen to what are their needs and their desires. Results of teachers' interviews show an articulated scenario, albeit with different emphases and nuances, confirming strong presence of Learning Design in teaching practice and the incessant teachers' inclination to carry out the design as a useful tool in their professional competencies and skills development.

From the interviews emerges that the factors that mainly motivate teachers to practice the Learning Design, despite the significant requirement of time necessary for its realization, are related to possibilities of facilitating to the teacher the orchestration of complex variables and helping him/her to prepare the set of practical and useful skills to face the reality of the class (cf. 3.4.1). Complementing the development of Curriculum Design, with the details of the aspects that characterize specific teaching activities, Learning Design involves the definition and articulation of times, spaces and resources to organize

educational activities that involve specific actors in specific acts (cf. 3.4.2).

For this practice to be effective, indications provided by teachers would be profitably combined with the Schön's epistemology of practice and the process of Learning Design should be extended through an iterative Design-Action- Reflection cycle (DAR) composed of the orchestration phase (the real design phase), the implementation of the designed activities with the students and the reflection on the carried activities. The Design-Action-Reflection model is supported by 3 different conceptions of technology that interact during all the design cycle and integrate it into a complex system (DAR3T): 1. technology is interpreted as a tool useful for representation, sharing and modification of Learning Design artifacts, 2. technology is conceived as a content that could represent the subject of educational activities, 3. technology is understood as a knowledge that enriches and influences pedagogical decisions and practical attitudes (Fig. 3.1). In this manner, by

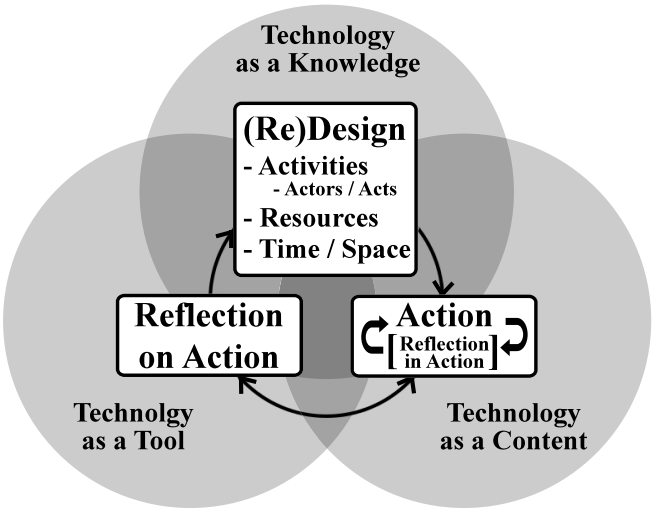

Figure 3.1: DAR3T Model

preparing a plan for a specific context, the teacher arranges, through the orchestration of educational activities using a limited number of simple and effective tools (cf. 3.4.3), a series of practical knowledge that will support him/her during the carrying out of the teaching activity. This practical knowledge (how, when and where to do) allows him/her to anticipate the educational variables and create a scaffolding structure for the reflection in action during the activities execution. Finally, after completing the educational activities and receiving the feedback from students, the teacher can reflect on his/her teaching action and re-calibrate his/her professional skills and competencies by means of the new acquired knowledge (cf. 3.4.4).

This shift of attention from the learning phase to the teaching and professional teacher development phase allows a more flexible Learning Design and releases it from rigid

schemes of implementation, by means of a continuous relation between the practical knowledge of the teacher and the specific and contextualized experience of teaching (cf. 3.4.5). Indeed, following this cycle, the teacher can return, by taking advantage of knowledge acquired during the process of design / action / reflection, to remodel the original design for a new use and adapt it to a different context.

For the teacher, the Learning Design phase and related produced artifacts are therefore decisive factors to establishing his/her own professional practice and to base the reflection on it on concrete instances. If, on the one hand, design allows through its modeling to tackle educational issues in a systemic way, and to have a global outlook able to highlight connections between the whole and the parts, on the other hand, the artifact produced by Learning Design represents the concrete evidence on which to base the reflection on-action and revise, contextualize and assert teacher's own thought and action framework.

To contextualize teacher's work means to relate it to the context and deal with it. Comparison, exchange, criticism and discussion based on the relationship between theoretical knowledge, i.e. pedagogical knowledge acted during design, and practical knowledge, i.e. the ability to read and interpret the educational reality to instantiate effective educational practices, represent fundamental factors for professional growth and training, and for knowledge sharing between experts and novices.

3.6 Conclusion

Learning Design is a fundamental process for the development of the teaching professionalism and for dealing effectively with the introduction of technology in learning and teaching. The conducted study has highlighted the need to consider not only the technical aspects and the sharing possibility of Learning Design, but also the relations of the design process with teachers' professionalism and their reflection about teaching practice.

In this horizon, the current challenge is to put design in a complex scenario, in which comparison and reflection on individual instances could serve as starting points for the emergence of flexible and reusable educational models through a personal and contextualized reinterpretation. To this aim, more studies are needed, both for the development of new models of design and for the development of tools and languages useful for the representation of the Learning Design in a realistic, comprehensible and effective way for teachers.

Chapter 4

Eliciting Requirements for Learning Design Tools: a Semio-Participatory Approach[1]

4.1 Introduction

In recent decades, significant socio-cultural changes and the rapid evolution of information and communication technologies have significantly modified the educational scenario, introducing greater complexity and numerous challenges to ensure the effectiveness of education. Regarding the use of technology in education, it has been acknowledged the need to properly design educational interventions, representing explicitly what students and teachers are planned to do [58]. In this scenario, Learning Design (LD), i.e., the design of educational actions, is a key factor that, if made accessible and usable by teachers, can bring significant benefits potentially improving results of educational practices [39].

The term "Learning Design" began to appear in the late 90's, in studies related to the Instructional Design field [59], although there is not yet a shared vocabulary within the research community. As highlighted by Dobozy [60], the field itself is called "learning design"[29], "instructional design"[30], "curriculum design"[31], "educational design"[32], "design for learning"[61] and "design-based learning"[34]. Another relevant position defines the field as "pedagogical planning"[62, 63].

Agostinho [64] provides a general definition for the process of LD as the representation of teaching and learning practices using a notational format. The aim of this practice is to create a plan of an educational intervention that can serve as model or template, adaptable by a teacher to suit his/her context and needs.

[1] A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Eliciting Requirements for Learning Design Tools: a Semio-Participatory Approach", unpublished.

Within a more technical point of view, Koper [65] defines LD as the description of the teaching-learning process that occurs in a unit of learning (e.g., a course, a lesson or any other designed learning event). It represents the learning activities and the support activities that are performed by different persons (learners, teachers) in the context of a unit of learning. For this purpose, the IMS Learning Design specification aims to represent the LD in a semantic, formal and machine interpretable way.

On the other hand, paying more attention to the sharing of experiences and professional growth of teachers, Conole [52] defines LD as a methodology useful to guide teachers to make more informed decisions, through the elicitation of pedagogical and practical knowledge. This general definition is not restricted to units of learning, but includes the design of resources and individual learning activities right up to curriculum-level design. From this perspective, the main purpose of LD is to help make the design process more explicit and shareable. As a research area, LD includes both the understanding of the design process, as well as the development of LD resources, tools and activities.

Starting from IMS-LD specification [27], many LD representations, software tools and design frameworks have been developed in the last years [52]. Nevertheless, despite these efforts, no evidence has been presented yet regarding simplifying the design process or gaining a wider audience among teachers not specialized in LD or not proficient in the use of technology [54, 37, 66, 36].

This paper investigates the subject by conducting a study with teachers of Italian as second/foreign language, located in different countries, aimed at understanding the meaning they make to a prospective system intended to support their practices of LD. The study is part of the Ledita (Learning Design for Italian Language) research project [47] that aims at developing practical solutions and theoretical knowledge related to LD. The project is inspired by the Educational Based Research methodology [19] and is developed with the collaboration of a group of Italian language teachers. Following the first research phase, devoted to the analysis and exploration of the problem through a usability evaluation of the latest generation LD software tools and an investigation of teachers' design practices, this paper describes and discusses results of the predesign phase, which was intended to clarify the raised issues and specify user requirements for the development of a LD software tool.

In order to promote a better understanding of end user needs and develop solutions closer to their teaching realities, we adopted the Semio-Participatory approach, based on the assumption that "including the user in the design process is vital to make sure we are creating systems that make sense and that are part of the users' context of life"[20]. Inspired by Organizational Semiotics [21], the Semio-Participatory framework integrates the system design with social and participatory practices: the technical level of technology design (the software system) presupposes knowledge of formal (forms and rules) and

informal (meanings, intentions, beliefs, responsibilities) social levels, understood by the analysis of signs carried by messages of participatory practices.

Among the methods and artifacts proposed by these theories for problem analysis and requirements specification, we selected the Group Elicitation Method (GEM) [67] and the Problem Articulation Method (PAM) [21]. The selection of these methods was motivated by their effectiveness in facilitating the communication among the participants on the problem clarification, definition and sharing of signs in useful for the elicitation and specification of requirements. To facilitate the participation of teachers involved in the research project, we adapted these methods and artifacts for use in remote and asynchronous mode, through forums and shared editable documents in the project website.

This paper describes the process and the results of the semio-participatory activities for the user requirement analysis of a LD software tool. The text is organized as follows: Section 4.2 introduces the background to the study; Section 4.3 illustrates the results of participatory requirement analysis activities; Section 4.4 presents the study findings; Section 4.5 discusses the results and Section 4.6 illustrates the conclusions of the study.

4.2 Background

The development of LD software tools has grown in recent years. To date, addressing different objectives and relying on various frameworks and methods, no LD software tool can be considered suitable for every situation, but each tool suits to different contexts, granularity and goals [68]. Nevertheless, a common aim has been to facilitate the sharing and reuse of educational ideas and support the reflection on practice [69].

Some of the most relevant systems are described in the next subsection.

4.2.1 Learning Design Tools

The IMS-LD specification three levels of implementation available: 1. the level A that contains all the core vocabulary needed to support pedagogical diversity; 2. the level B that adds Properties and Conditions to level A; 3. the level C that adds Notification to level B. Since IMS-LD, some of the most relevant systems - CADMOS, COLLAGE, CompendiumLD, OpenGLM, RECourse, are briefly presented as follows.

CADMOS CADMOS (CoursewAre Development Methodology for Open instructional Systems) [70] is a graphical editor that intends to allow educational practitioners to build,

revise and visualize the desired LDs. The creation of a LD is divided into three phases: 1. The definition of metadata, 2. The creation of the conceptual level, with the definition of activities, actors and resources, and 3. The specification of the flow model with the organization of the activities and the specification of the navigation rules. CADMOS is integrated with Moodle and allows to export an IMS LD level A and B compliant design.

Figure 4.1 shows the tool interface for the creation of the conceptual level.

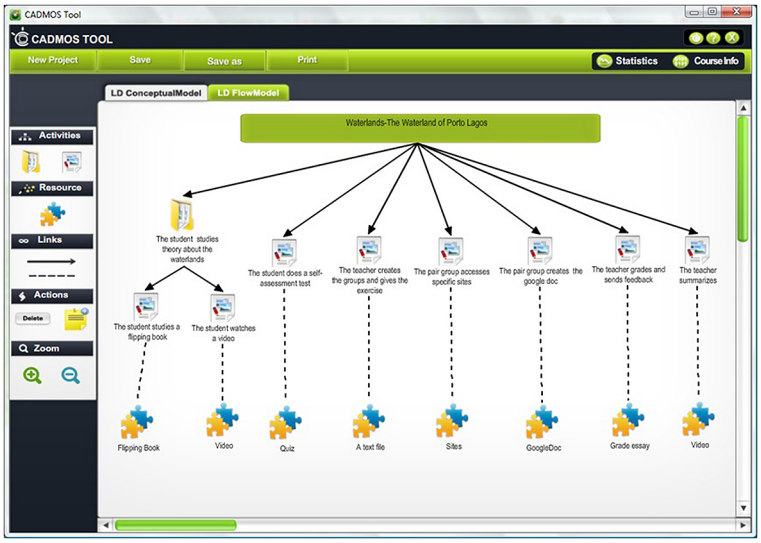

Figure 4.1: CADMOS (conceptual level interface)

COLLAGE COLLAGE (COLlaborative LeArning desiGn Editor) [41] is a graphic-based LD authoring tool for computer supported collaborative learning (CSCL) environments. It is integrated in RELOAD [42], an IMS-LD full compliant LD editor, which provides a plug-in framework, and it is IMS-LD level A compliant. The creation of a LD is a process of particularizing and adapting a collaborative learning flow pattern (CLFP), selected in a provided repository, according to the requirements of a particular learning situation.

Figure 4.2 shows the tool interface for the edition of a learning activity.

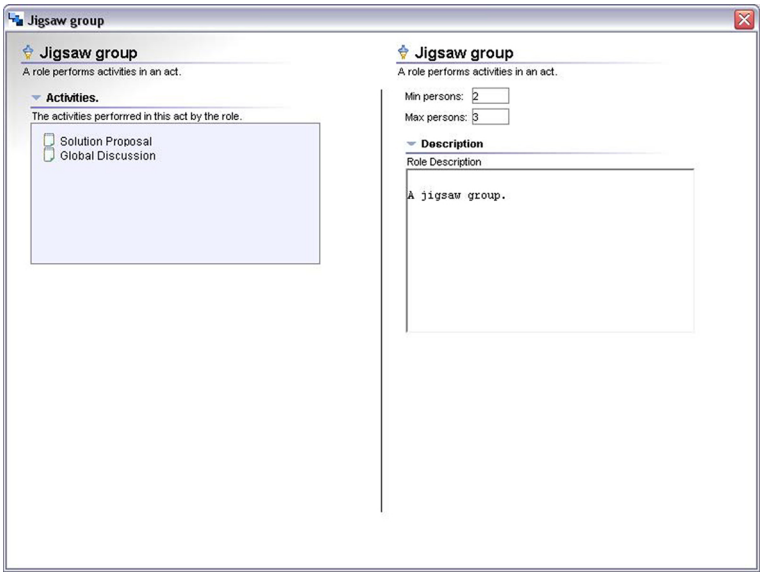

Figure 4.2: COLLAGE (learning activity editor interface)

CompendiumLD CompendiumLD [71] is a visual tool that adds a set of specific LD icons and tools to the Compendium Tool [44]. It does not produce an IMS-LD compliant design and its aim is to make the design process more explicit and to promote the share and reuse of LDs by making available a repository of shared designs.

Figure 4.3 shows the CompendiumLD interface with the set of LD icons on the left of the window.

OpenGLM OpenGLM (Open Graphical Learning Modeler) [72] is based on GLM. It is an authoring tool aimed to support the building of a community of practice around standard-based instructional models. OpenGLM is connected to a repository of open educational resources and produce IMS-LD Level A and B compliant designs.

Figure 4.4 shows the main interface of OpenGLM.

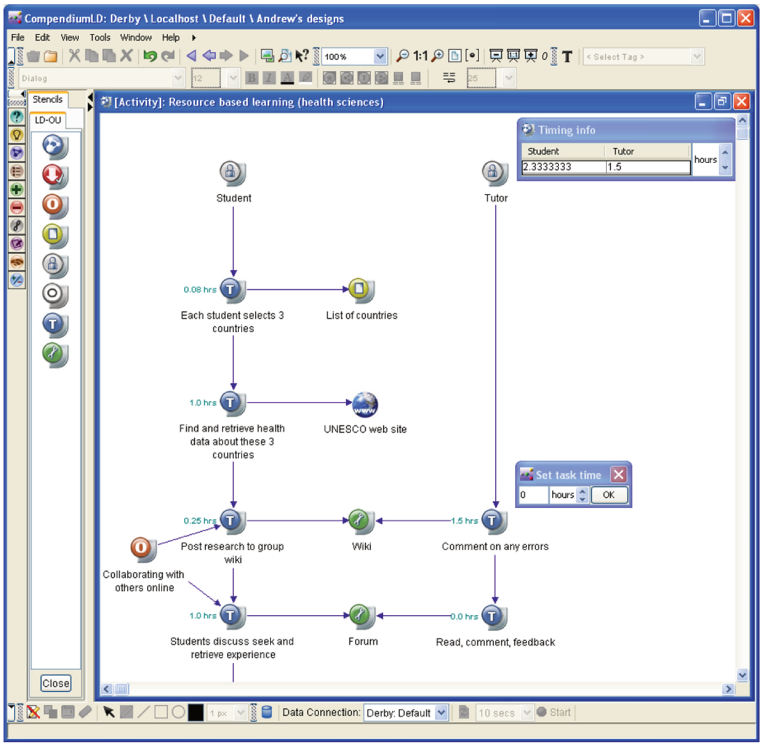

Figure 4.3: CompendiumLD (main interface)

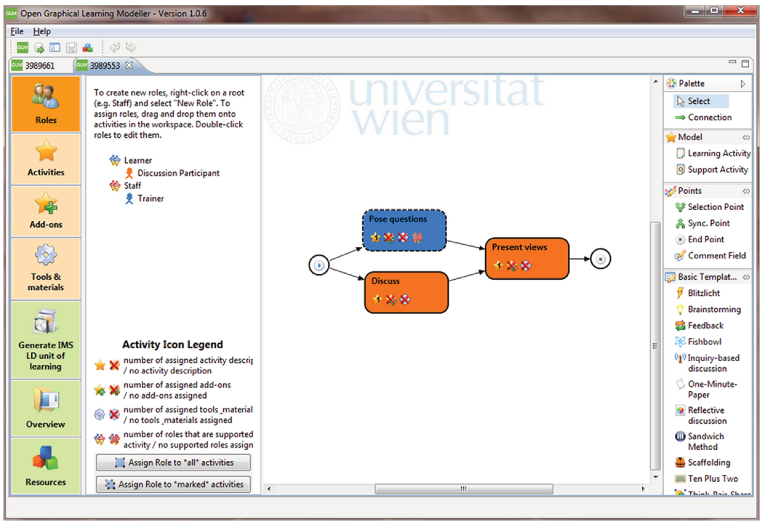

Figure 4.4: OpenGLM (learning activity editor interface)

ReCourse ReCourse [46] is a visual editor designed as a successor to the RELOAD. To support users in their engagement with IMS-LD, usability improvements were developed

including a simplified authoring interface, access to repositories and a general reinterpretation of the IMS-LD metaphor, hiding the tree structure in favor of a freer spatial organization, allowing to change the terms indicated in the specification (e.g. play can be set to course) and simplifying the concepts of the specification (e.g. role part is inferred from a relationship between a role and an activity). ReCourse is an IMS-LD Level A, B and C compliant.

Figure 4.5 shows the interface of ReCourse for the definition of the design structure.

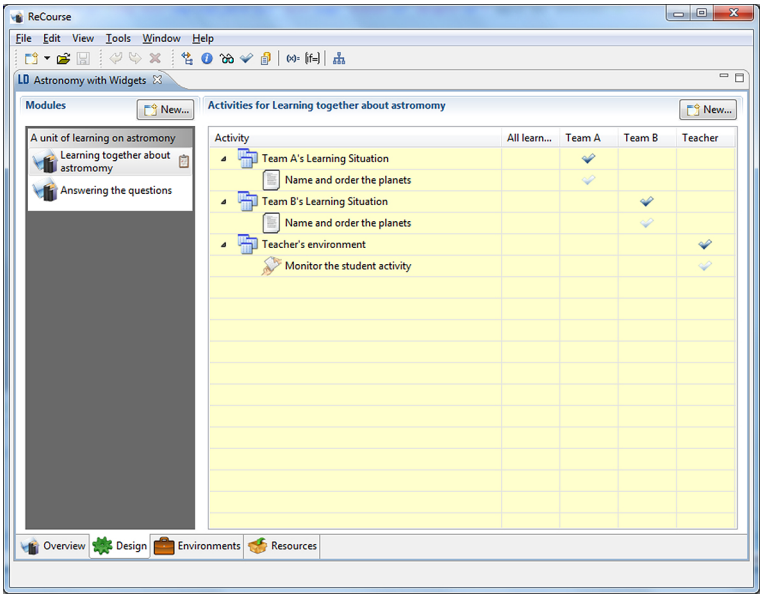

Figure 4.5: ReCourse (activity structure interface)

4.2.2 The design process enabled by the Tools

All the presented tools adopt a graphical interface and a visual language to produce and represent a LD. The process of LD creation is more defined and strict by the adherence to the IMS-LD specification for ReCourse and OpenGLM, and for the adaptation of a CSCL model for Collage. CADMOS and CompendiumLD implement a higher level process: the first, splitting the creation into the definition and the orchestration of activities, the latter, with a multilevel structure of navigation, composed by specific icons and contents.

In general, these software tools intend to provide a simple interpretation of LD and to support the diffusion of LD (process and product) among teachers, through a focus on a better development of their user interfaces and metaphors. This trend confirms the claim that the more distant from the specification and specific purpose the tools are, the more

valuable the supported design process may be [41].

4.3 The Study

The Ledita project counts on about 90 participants, who are teachers of Italian as second/foreign language from 16 countries. All teachers had a Liberal Art education with a multidisciplinary background and most of them had a tertiary education and a multi-years teaching experience. They were asked about their relationship with technology and none of them said to have a negative one, whereas the majority declared to have a good or excellent relationship. The most commonly used technologies were computer, smartphone and tablet in private life, and computer and interactive whiteboard in professional life. With regard to their experience with software tools, all the participants used Internet; most of them had an e-mail address and an office suite, and some of them a graphics program and a video-editing tool.

In this study, interactions among teachers took place in an asynchronous way through the project website, where participants used forums, editable web shared documents (Google Drive) integrated in the website and specific forms for the completion of research activities.

The selection of participants for the activities conducted in the requirements phase was made through proposition to volunteers among teachers involved in Ledita project. The number of participants was 7, the optimal number as suggested by GEM methodology in order to obtain a productive session in a reasonable time, and we maintained this group along all the activities. The selected teachers come from Argentina, Brazil, Greece, Ireland and Italy and, as the others, are specialized in teaching Italian as second / foreign language. All the teachers had participated in previous LEDITA's research activities, usually carry out LD in their teaching practice and were previously introduced to the main software tools available for educational design and planning.

After discussion through an initial forum about some actual LD representations and tools, the teachers completed GEM activities in order to explicitly describe the concepts that characterize an ideal LD tool and to hierarchically classify these concepts. After reaching a consensus, results were critically discussed and teachers proceeded to the PAM activities. The aim of this second group of activities was: a) to elicit interested parties in the prospective software tool, with the Stakeholder Analysis artefact; b) anticipate possible problems and propose solutions, with the Evaluation Framing artefact and, finally, c) organize and discuss the results, highlighting eventually open issues, with the Semiotic Ladder artefact.

The next subsections describe the GEM as well as the PAM, their artefacts and the

way they were used.

4.3.1 The Group Elicitation Method

The GEM [67] is a participatory practice we can locate in the initial stages of the software lifecycle, which aims at eliciting end-users' knowledge for the design of new user interfaces and complex human-machine systems. This participatory design method consists of the elicitation of important concepts from end-users' viewpoints and in deriving a consensus among the participants, using a brainstorming technique combined with a decision support system. A GEM session is usually composed by six phases: 1) Formulation of issue statements; 2) Generation of viewpoints; 3) Reformulation of viewpoints into more elaborate concepts; 4) Generation of relationships between these concepts; 5) Derivation of a consensus; 6) Critical analysis of the results.

The original phases of GEM were adapted to fit our research scenario in which the subjects had to participate at a distance, as follows:

Formulation of issue statements For the formulation of issues statements, based on the list proposed by Nielsen et al. [73], a structured interview was created and proposed to participants through a shared web document that teachers could simultaneously edit. The questions, translated into Italian, were as follows:

- What is the goal of the engineered system that we plan to design or evaluate?
- How is the system or its equivalent being used (current practice, observed human errors)?
- How would you use this system (users' requirements)?
- What do you expect will happen if the corresponding design is implemented (e.g., productivity, aesthetics, quality of work product, quality of work life, and safety issues)?
- How about doing the work this way (naive or provocative suggestions)?
- What constraints do you foresee (pragmatic investigation of the work environment)?

Generation of viewpoints This phase consisted of a "brainwriting", a collaborative written brainstorming, aimed to highlight the points of view of the participants in relation to the questions posed in the structured interview. In this study the viewpoints were collected through their collaborative writing of a single document using Google Drive. The participation of the teachers in this activity lasted 3 days, with contributions and comments inserted directly into the shared document.

Reformulation of viewpoints into more elaborate concepts For the elaboration of viewpoints into concepts, participants highlighted possible important concepts in the text and then analyzed and developed a list of concepts by means of combinations and divisions, always using collaborative writing through Google Drive.

Generation of relationships between these concepts For the identification of relationships between concepts a form was created in the project website in which participants had to choose whether a concept was more important (+1), equally important (0) or less important (-1) compared to all other concepts mentioned. The objective of this artifact, called "triangular matrix", is to serve as decision system for the classification and organization of concepts obtained from previous stages.

Derivation of a consensus For the derivation of consensus, a data analysis of each participant's matrix obtained during the phase 4 was carried out, by the creation of a global matrix of the scores assigned to the relationships between concepts. Starting from the global matrix it is possible to derive the consensus, which is expressed with 4 parameters:

- The mean priority (MP) of a concept corresponds to the mean of the scores assigned to a concept with respect to the other concepts by all the participants. The value range of the mean priority is the interval [-100, +100].
- The interparticipant consistency (C) of a concept corresponds to the mean of the standard deviations of all global scores.
- The mean priority deviation (D) or stability of a concept corresponds to the standard deviation of the mean priority with respect to the global scores of a concept.
- The global consensus (GC) expresses a global score of the group consensus on the investigated issue.

Critical analysis of the results Finally, results obtained from previous phases were presented to the participants, who have analyzed and commented on them using a forum in the website project.

4.3.2 The Problem Articulation Method

The PAM [21], developed in the later 1970s by Ronald Stamper within the MEASUR (Methods for Eliciting, Analyzing and Specifying Users' Requirements) research project, provides a set of techniques and tools that enable to understand and clarify problems. By using the method, undesirable omissions from analysis and specification can be reduced. Specifically, for the Ledita project, the same participants of previous GEM activities, always in remote and asynchronous activities, have used three artifacts: 1) Stakeholders Analysis, 2) Evaluation Framing, 3) Semiotic Ladder.

Stakeholder Analysis This artifact allows investigating the involved parts that direct or indirectly influence or interest the information system under analysis. It is based on the technical, formal and informal levels of participation and organizes the stakeholders into five categories: Operation, Contribution, Source, Market and Community. To carry out this analysis, a document in Google Drive was prepared with the five stakeholders categories that participants filled in with their suggested stakeholders.

Evaluation Framing The second activity consisted in completing the results obtained from the stakeholder analysis, by anticipating, for each stakeholder category, problems, questions and related issues and suggesting possible solutions [74]. For this activity, we prepared a Google Drive document with a table that, resuming the results of the Stakeholder analysis, added 2 columns to every stakeholder category: the first concerning problems/questions related to those stakeholders, and the second concerning ideas/solutions related to the raised issues.

Semiotic Ladder To complete the PAM, participants filled in the Semiotic Ladder, an artifact useful to organize the different levels of requirement information. Besides the traditional semiotic division of syntax, semantics and pragmatics, the Semiotic Ladder of Stamper [75] adds three new levels: "Physical World", "Empirics"and "Social World"(Figure 4.6).

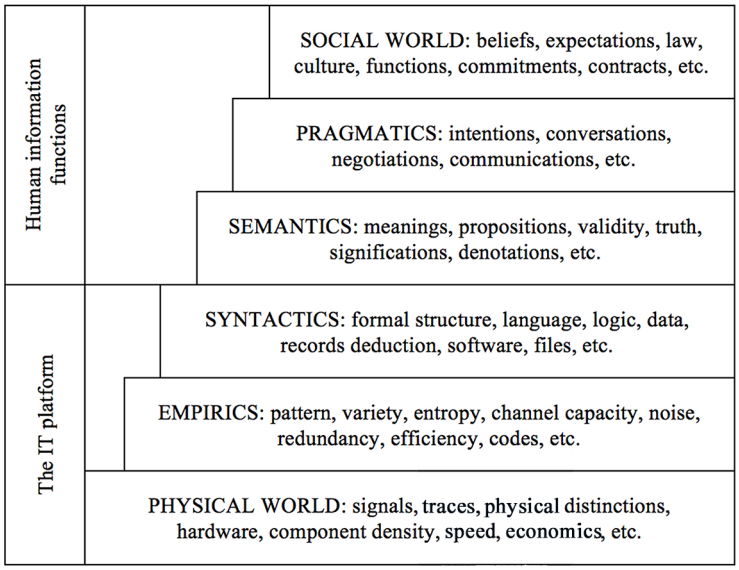

Figure 4.6: Original Semiotic Ladder (from [65])

The activity of the participants in this study consisted in completing the various levels of the Semiotic Ladder starting from the stakeholders list suggested in previous analysis and indicating open questions and possible solutions for each level of the ladder. As for precedent activities, participants wrote their contributions directly in a web-shared document created with Google Drive.

4.4 Results

Results from GEM and PAM activities were collected in text documents and spreadsheets and manually elaborated for analysis.

4.4.1 Findings on the Group Elicitation Method

For GEM activities, the teachers' participation was intense and every point of the issue statements was commented with the creation of articulated and connected viewpoints. Then, through several rounds of elaboration, 12 concepts were highlighted, interpreting and organizing the five-page document created in previous phases.

The selected concepts were:

1. Support to Design,
2. Graphical Representation of Designs,
3. Consideration of Educational Needs,
4. Support to Reflection,
5. Economy (Time),
6. Ease of Use (Short Learning Curve),
7. Sharing of Designs,
8. Reuse of Designs,
9. Collaboration,
10. Author Identification,
11. Aesthetics (Look and Feel),
12. Software Compatibility.

In the generation of relationships between the concepts, we obtained a triangular matrix for every participant. Table 4.1 shows an example of triangular matrix created by one participant (+1 = more important, 0 = equally important, -1 = less important).

By collecting the triangular matrix of all participants, we obtained the Global Score matrix (see Table 4.2). In this Table, the value of a single cell is related to the sum of all scores assigned by a participant in the triangular matrix to the relations of that concept with all the other concepts.

Table 4.1: Triangular Matrix of participant 2

		Concepts										
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Concepts	**1**	0	0	0	-1	-1	1	0	1	1	1	0
	2		-1	-1	-1	-1	1	-1	0	1	1	-1
	3			0	-1	-1	1	0	1	1	1	-1
	4				-1	-1	1	0	1	1	1	0
	5					1	1	0	1	1	1	0
	6						1	0	-1	-1	-1	1
	7							-1	0	1	1	-1
	8								1	1	1	-1
	9									1	1	-1
	10										1	-1
	11											-1

Observing the Global Score obtained by each concept, we can notice that "Support to Reflection" and "Consideration of Educational Needs" were the most important concepts for participants, followed by "Ease of use (short learning curve)", "Economy (time)", "Reuse of designs" and "Support to Design", all with a positive score. "Sharing of designs" was understood as neutral, whereas "Software Compatibility", "Graphical representation of designs", "Collaboration", "Author identification", "Aesthetics (Look and feel of the software)" received a negative evaluation in relation to other concepts, meant to be less important.

In relation to the consensus analysis, results of Table 4.3 show that Mean Priority reflects the Global Score, with a sufficient uniformity of evaluation among the participants, except for the two most and, especially, the less important concepts, for which Mean Priority Deviation increases to exceed 5 points. These last values have therefore reduced the level of homogeneity, as we can see even from the relatively high Interparticipant Consistency value and from the Global Consensus that is slightly negative.

Table 4.2: Concepts Relationships Global Score Matrix (Higher score for more important concepts)

Concepts	**Participants**							**Global**
	1	2	3	4	5	6	7	**Score**
Support to Reflection	7	3	-3	-1	6	4	7	**23**
Consideration of Educational Needs	7	2	1	-5	6	4	6	**21**
Ease of Use (Short Learning Curve)	0	6	-3	9	1	3	1	**17**
Economy (Time)	4	9	-1	7	-8	-2	3	**12**
Reuse of Designs	2	4	-2	6	3	4	-5	**12**
Support to Design	-2	2	3	-5	2	-1	8	**7**
Sharing of Designs	2	-6	0	5	3	2	-6	**0**
Software Compatibility	2	8	-2	-5	0	3	-8	**-2**
Graphical Representation of Designs	-1	-3	3	-5	-2	-6	7	**-7**
Collaboration	-5	-5	-5	6	5	1	-6	**-9**
Author Identification	-7	-9	9	-11	-9	-5	-5	**-37**
Aesthetics (Look and Feel)	-9	-11	-1	-1	-8	-7	-2	**-39**

Table 4.3: Consensus Analysis (Lower score for mean priority deviation means higher consensus)

Concepts	**Mean Priority**	**Mean Priority Deviation**
Support to reflection	29,87	3,44
Consideration of educational needs	27,27	3,14
Ease of use (short learning curve)	22,08	2,54
Economy (time)	15,58	1,79
Reuse of designs	15,58	1,79
Support to Design	9,09	1,05
Sharing of designs	0	0
Software Compatibility	-2,6	0,3
Graphical representation of designs	-9,09	1,05
Collaboration	-11,69	1,34
Author identification	-48,05	5,53
Aesthetics (Look and feel of the software)	-50,65	5,82
Interparticipant Consistency: 4,34		
Global Consensus: -2		

4.4.2 Findings on the Problem Articulation Method

Results of the Stakeholder Analysis reported 19 stakeholders potentially interested in the system. Grouped in the categories of analysis, they are:

- Operation: Teachers, Students, Authors of didactical materials, Curriculum administrators;
- Contribution: Project participants, Software developers, Researchers;
- Source: Italian language teachers, Web system;
- Market: Universities involved in the research, LD software tools, Sponsors;
- Community: School directors, Faculty chairs, Media, Students' families, Teachers' families, Libraries, Scientific community.

Figure 4.7 shows the results of stakeholder analysis in the Google Drive created by the participants.

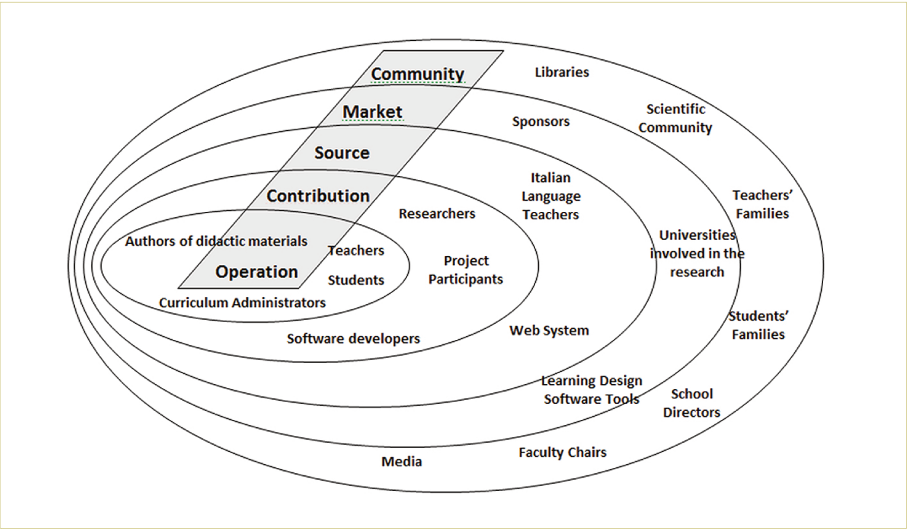

Figure 4.7: Stakeholder Analysis

For the Evaluation Framing, participants filled in the predisposed form with 13 questions/problems and 11 ideas/solutions to solve these issues. Table 4.4 shows an excerpt of the Evaluation Framing structure, related to source stakeholders.

Finally, results of the Semiotic Ladder show a good participation for the three first levels (social world, pragmatics and semantics) and a more synthetic participation for the

Table 4.4: Excerpt of Evaluation Framing

Source		
Stakeholders:	**Questions and Problems:**	**Ideas and Solutions:**
Italian Language Teachers, Web system	If the system is a web application, it needs an Internet connection to work. If a connection is not available, the system turns unusable.	Make available a system version that can be used without an Internet connection and provide the ability to upload the material developed offline when a connection is available.

more technical levels (syntactics, empirics, physical world). Table 4.5 shows an excerpt of the Semiotic Ladder.

Table 4.5: Excerpt of Semiotic Ladder

Social World	**Elements:**	**Open Questions:**
	Allow teachers' reflection on their teaching practice and facilitate a more efficient use of technologies in education.	Could culture, values and emotions of teachers affect the use of software? Are there laws that may create obstacles to the sharing of designs and resources? How to ensure compliance with the copyright for the used resources?

4.5 Discussion on the Main Findings

Results of the GEM activities showed essentially a strong interest of the participants in issues that are closely related to the practice of teaching. The main indication that comes from the elicitation and hierarchy of these concepts is the importance of LD as a

moment of reflection and professional growth. This affirmation arose from the priority of "Support to Reflection" concept and from two explicit references in viewpoints for design practice as opportunity for professional growth. The supporting action is seen as a design flexibility that allows the "Reuse of designs" (appeared in concepts) and the revision and adaptation of designs to "Educational needs" (both in concepts and viewpoints).

This request for flexibility opens a new scenario in the horizon of LD tools to date, characterized by two main tendencies. The first is to support the design process via a user-friendly visual design environment, based on specific design principles and philosophies [66]; the second, is to help and guide teachers to take decisions during the design process [76]. However, teachers request a freer design process that is able to support and not constrain their ideas, choices and decisions.

The flexibility is especially required by teachers' interest in ensuring the valorization of LD actors and resources. For the actors, the consideration of all possible subjects of an educational action is important, be they children, adults, elderly or with special needs (four participants mentioned these during the generation of viewpoints). Concerning the resources, in facilitating the reuse and dissemination of educational materials previously created (three mentions in the viewpoints). The reuse of a LD is also motivated by the considerable amount of time required to design ("Economy" concept). In order to minimize this problem, a strong demand for usability and simplicity of the software emerged from teachers ("Ease of use" concept).

The importance attributed to the reflection on teaching practice and to the reuse of projects after a re-adaptation to the new context of use has contributed to the positioning of sharing of designs with other teachers in a secondary position ("Share of designs" concept collected MP = 0). This indication seems to go against the viewpoint of many LD experts, who argue that the sharing of designs between the community of practitioners is fundamental [77, 78]. This is probably due to the fact that teachers have understood the sharing of designs as a not very useful activity if automatically done and not accompanied by reflection and the possibility to adapt the design to their needs (two teachers explicitly affirmed this in the viewpoints). This could also be due to the fact that there is no common language for describing online and face-to-face educational experiences [56].

Analyzing the viewpoints created by participants during GEM activities, we can highlight some interesting aspects. First, text emerged as a main representation modality for the design and graphical representations were limited to marginal roles. Furthermore, participants have always reported text editors as the main design tool that allows describing educational activities in detail. This indication contrasts with the current trend of LD software tools, for which, the representation is mainly graphical, using flowcharts, columns or concept-maps [52].

Little significance was given to the possibility of designing in a collaborative way

(no explicit mention in the viewpoints and negative score for the mean priority of 'collaboration' concept). This indication highlights the importance and uniqueness of the relationship between designer, educational context and teaching materials (reported in three different parts of the document). In this relation, the teacher/designer him/herself is seen as part of a system and not as the owner of an educational project (as shown by the negative score for the mean priority of the 'author identification' concept). Another point is the possibility of taking into account the copyright rules for the use of specific educational resources. This element has been considered in GEM viewpoints, in the Evaluation Framing and in the Semiotic Ladder.

Concerning the more technical aspects, teachers have shown interest in a system that can adapt to multiple operating systems and devices. This request was made in order to make the system accessible by schools with poor technological structures. Finally, a lack of interest, although with a few exceptions, in the aesthetics of the software, reaffirming the need for simplicity and familiarity with the most common systems, especially text editors. In relation to PAM activities, the stakeholder analysis has enriched the relationship between teachers, context and learning materials emerged from GEM, emphasizing the need to consider, in addition to teachers and educators, creators of educational materials, pedagogical coordinators and school managers. The presence of these stakeholders has led the discussion within the evaluation framing trough aspects related to the management of the copyright for educational materials and the license to be applied to the software. The emerged intention, in line with current trends, was to move toward open materials and resources, allowing the interaction with the web for their retrieval, and to distribute the software with a free use license.

Another element of reflection was the difficult relationship of many teachers with technology, although they had considered themselves as knowers of technology in the first phase of the Ledita project. This difficulty appeared in relation to the use of tools other than those they are accustomed (office suite and graphic programs), and the frequent limitation of technological resources of the schools. In this regard, teachers stressed the importance of compatibility of the system with different devices, to provide simple and quickly visible instructions of use, and to generate a printing version of LDs, in order to facilitate the activities in the classroom, even in the absence of technological resources. The Semiotic Ladder, finally, has encouraged a lively dialogue among teachers that has enriched previous discussions and has allowed analyzing elements of extreme importance for the development of the software. First, at the level of the social world, the reference to design as a tool for reflection on professional practice; efficiency in the use of technology in education has strengthened the demand for the development of an open system that makes the web a source of stimulation for the exchange and dialogue between cultures. This interpretation gives a new importance to the sharing of designs, which is not seen

as an end, but as a motivation to the improvement and professional growth by means of the example and the re-elaboration of designs.

To this end, with the pragmatic level, the demand for flexibility of the software is found to be of fundamental importance for the success of the system. To allow adequate representation and fruitful sharing of designs, it is necessary a dynamic categorization of the elements that compose the designs. This could be achievable by allowing the customization by teachers, to suit their specific needs and better adapt to the educational context. In fact, one of the main limitations encountered by participants during the initial analysis of existing systems was the narrowness of some categorizations and the lack of possibility to add new elements.

Concerning flexibility and the good usability of the system, the semantic level brought the need to provide searching tools to explore all the possible design contents and combine the textual representation of the designs with a graphic summary that allows a global overview on the elements that compose the designs. Syntactic, empirical and the physical world levels have focused the attention on the development of a web-based system, that should allow safe access to users through a free registration service and the ability to be used on different types of devices, including desktop computers, laptops and tablets.

Summarizing, the main user requirements indications for the prospective LD tool, as resulted of this study, are listed as follows:

- Reflection and professional growth are the main aims for design practice and sharing. This indication requires the use of high level language and the selection of metaphors closer to teaching practice;
- Reuse of design is important for time economy and to stimulate the sharing of experiences, but only if designs can be modified and adapted to the new context of use;
- Flexibility is a key factor to adapt designs to every educational context. It is referred to the definition and orchestration of actors, resources and activities, using dynamic categorizations;
- Usability and simplicity are important for the diffusion among teachers;
- Text is the preferred modality of representation, whereas a graphical representation is useful for a global overview of the design;
- The system should be a web application to allow the use of different operational systems and devices;
- The use of free web resources allows avoiding copyright issues for didactical material.

4.6 Conclusion

LD is a key element to achieve positive educational results, but systems available today to support the LD process have not yet reached teachers and an adequate level of usability. This paper investigated the subject by conducting a study with teachers of Italian as second/foreign language, to understand the meaning they make to a prospective system intended to support their practices of LD.

This study involved the use of semio-participatory practices with a group of teachers at a distance, to understand the meaning they make to issues regarding LD practices and representations, aiming at eliciting user requirements for a prospective LD tool. The participatory requirement analysis activities carried out with the teachers have revealed aspects of the professional world of potential end-users and their needs and expectations. These participatory activities were well received by the participants and the remote asynchronous modality of participation has allowed us to complete the activities within a reasonable time and with a sufficient level of detail and involvement.

Analyzing the results, it was possible to synthesize a number of practical indications useful for developers interested in development informed by the practice of the main interested parties, who can rely on contextualized and well-argued information. Future works in this investigation involve the formalization of a conceptual framework able to support reflection and professional growth within the practice of educational design and the development of a system capable to respond to the user requirements emerged from this study.

Chapter 5

Learning Design for Reflective Teachers: the LEDITA Approach to Professional Growth[1]

5.1 Introduction

The design in education, especially as interpreted in the Learning Design research field (LD), mainly addresses the issues of formal representation and sharing of educational designs in the context of the online learning [79]. Such practices, if made accessible and usable by teachers, should enable the sharing of educational experiences and promote the integration of technology in education [39]. With this aim, many LD representations, software tools and design frameworks have been developed in the last years [52]. Nevertheless, despite these efforts, no evidence has been presented yet regarding simplifying the design process or gaining a wider audience among teachers not specialized in LD or not proficient in the use of technology [54, 37, 66, 36].

This paper proposes an approach to LD that considers the practice and reflection of teachers as key elements for the design of educational activities. The aim of this approach is to foster an effective use of technology and a professional growth for teachers of Italian as second/foreign language by means of an improvement and a critique organization of their teaching repertoire.

[1] A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Learning Design for Reflective Teachers: the LEDITA Approach to Professional Growth", unpublished.

5.2 The Design Practice

The concept of design is frequently linked to the union of art and technique. It brings together the aesthetic thought, characterized qualitatively, with the technical rationality and the scientific thought, characterized by a quantitative emphasis, for the ideation and accomplishment of an objective [80]. The Oxford Dictionary defines design as "the art or action of conceiving of and producing a plan or drawing of something before it is made" [81], paying attention to the dual activity that precedes the creation of an artefact, i.e., the ideation phase and the production of a plan. Terzidis [82] details this double connotation by arguing that the production, organization and execution relate to the planning, whereas the design is characterized by conceptualization, imagination and interpretation.

From this perspective, the design is characterized as a creative activity, aimed to the invention, i.e., create a totally new artefact, or to the innovation, i.e., redefine or expand the features of an existing artefact to provide a new interpretation [83]. The design is not a mere application of technical rules, nor, on the other hand, a complete abstraction from the reality and a reliance on the freedom of creation. It finds its full expression in the balance and commingling of creative knowledge, able to join, to put together, with the technical know-how, which provides the knowledge of the world where is possible to invent or innovate. This technical rationality draws the attention to the context, to the scenario with which the creation has to confront in order to propose a solution not only innovative, but also functional and effective.

The design characterizes many activities and professions. Among them there are not only those most closely related to the production of material artefacts, which contains a form or pattern after which something else will be made [84], as for example in architecture, engineering or fashion, but also activities in which the design is not necessarily formalized and can remain a mental and implicit plan, as often happens in education [85]. In this second case, the lack of a tangible result sometimes makes it difficult the identification and the valorisation of the design activity. However, as pointed out by Goodyear and Dimitriadis [86], the design begins to be recognized as an outlined and significant activity in the practice of teachers [61, 52, 87, 69, 88].

5.3 Design in Education

The effective use of technologies in education requires a careful preparation activity by the teacher. In fact, the teaching practices used in face-to-face education differ from those used in online education, and the transition from one modality to another is problematic and not always obvious [89]. It is not possible to merely transfer the practice of face-

to-face teaching to the online education, since the change of the implementation context implies the presence of new variables and emergent behaviours, which are more than the sum of the individual parts and arouse new effects [90]. Therefore, in order for teachers be considered as real practitioners, it is necessary to consider them placed in a real and well-defined context [41]. In this way, the context of the educational action becomes the horizon of meaning that characterizes the teaching/learning and situates every single interaction [91, 92].

Dealing with the educational context, however, requires special attention. In fact, as highlighted by Dimitriadis e Goodyear [93], it represents a complex and often unpredictable scenario, characterized by epistemic, physical and social interactions. Each educational experience is characterized by a certain selection and organization of knowledge, by the use of resources and educational materials, and by the presence of social relations, which make unique every interaction. For the dialogue and the integration of these elements, the teacher requires a specific competence to correlate technologies, epistemological content and pedagogical knowledge, and to establish the grounds for a new teaching practice [26]. This afterthought of his/her professional practice is possible only if the teacher asserts him/herself as a fundamental element of the educational process and considers his/her values, experiences, beliefs and pedagogical principles as crucial factors for the educational activity [50]. In fact, teachers thought plays an important role in defining the knowledge and skills that make a teacher a professional in education, who has a specific practice that allows him/her to act the theoretical knowledge to achieve specific objectives in complex situations.

Starting from these theoretical coordinates, the LD should be characterized as a professional practice that brings together specific knowledge, physical resources, skills and attitudes in the horizon of a complex context, in order to foster better educational results and a more effective use of technology in education. However, despite the main definitions of LD describing the activity of design as a process of teaching and learning [64, 52, 65], LD has focused mainly on the creation of learning paths basing on didactical resources and available technologies, and taking care of the presentation, management and distribution of content [94]. This tendency focuses on the physical and epistemological aspects, leaving aside almost all the social aspect of interaction and the teachers' thinking. We can consider this attitude as an expression of the positivist tradition aimed to the product, i.e., the learning, which can be obtained via a linear and prescriptive path: is sufficient to follow a set of rules and guidelines suggested by learning theories to ensure effective educational outcomes [95].

As an alternative to the model aimed to the product, we can consider the model of design aimed to the process. In this way, learning is not the direct object of the design, but the final aim to which the design tends, as well as the Beetham and Sharpe's [33]

definition of "design for learning" seems to suggest. With this connotation, the learning is not a predictable and controllable phenomenon, but the result of an educational action in a complex context, characterized by unique, uncertain and conflicting situations. In this scenario, the teacher, i.e., the professional of education, links the unique event to his/her teaching repertoire and experiments new modes of action. This activity is enacted with a cycle of reflection-in-action, during the action, and reflection-on-action, after the action, that builds a conversation with the situation and allows criticizing the repeated experiences and make sense to new practices [23]. This cycle of design, action and reflection make the teacher a reflective professional, whose distinguishing characteristic is the *Phronesis*, i.e. the practical knowledge oriented to the concrete situation that allows to grasp the details and to deliberate with in action choices made and measured with the context [96].

5.4 Toward the definition of a design model

This work is part of the LEDITA (Learning Design for Italian Language) research project[2], aimed at developing practical solutions and theoretical knowledge related to LD and teaching of Italian as a second/foreign language (L2/LS). The project is inspired by the Educational Based Research methodology [19] and is carried out with the collaboration of Italian language teachers from various Countries.

The first research phase, devoted to the analysis and exploration of the problem, consisted in a usability evaluation of latest generation LD software tools [54] and an investigation of teachers' design practices [97]. These studies have highlighted the potential related to the use of LD as a tool for reflection on the practice of teachers and have underlined useful information to understand the needs of teachers in relation to the LD and the practice of teaching. It has also been shown the importance of developing good levels of usability, in order that teachers non-specialized in design can usefully and widely use LD software tools.

During the second research phase, devoted to the predesign, user requirements for the development of a LD software tool were defined, using a semio-participatory approach [98]. The results of this study, as well as numerous practical suggestions, have shown a strong demand for flexibility, so that a design can be created, adapted and reused in the best way in relation to the context to which it refers.

[2] http://www.professoreitaliano.com

5.5 LEDITA Approach

The design of a didactic action unfolds as a dialogue with the educational context in an iterative motion that goes from the definition of general elements to those specific of a single activity. These General Information and specific activity details constitute the structure of an atomic educational action, characterized by epistemological, physical, social and temporal coordinates. The creation of a project begins with the General Information section, i.e., the common information for all the possible activities that compose a design. This section is composed by: scope, duration, language level, objectives, prerequisites and students and context description.

- The scope concerns the area of interest of the project, such as a single activity, a unit of learning, a lesson, a module, a semester, etc.

- The duration defines the timing of the design, with minutes, hours, days and months. It is also possible to set a free duration; this means that the teacher or the students are called to decide the duration when the design will be executed.

- The language level is defined according to the Common European Framework of Reference for Languages [3] and is divided into 6 levels: A1, A2, B1, B2, C1, C2.

- The objectives and prerequisites relate to the skills and knowledge to be achieved or are necessary for the performance of activities by the students.

- The students and context description, finally, allows to detail the recipients of the design and each element that the teacher/designer considers relevant in the definition of the setting.

To the General Information definition follows the creation of activities. An activity is composed by: modality, duration, students' organization, technologies, resources, activity description, didactic suggestions.

[3] http://www.coe.int/t/dg4/linguistic/

- The modality allows to choose whether the activity is in person, carried out face-to-face with students, whether it online, to be conducted at a distance, or if is blended, a part in person and a part online.

- The definition of the duration follows the same structure of the design duration, but this is referred to the activity.

- The students' organization allows defining whether the activity should be carried out by the entire class, by each student individually, in pairs or in groups. In the case of activities in groups, it is possible to define the number of groups and/or the number of students per group.

- The technology field allows defining a list of tools used to carry out the activity. For this section the term technology is understood in a broad sense, including not only informatics or digital solutions, but also the tools commonly used in teaching, such as the blackboard or the exercise book.

- The resources section allows connecting to an activity of one or more didactic materials. Each resource is defined by a name, a type (for example: document, image, video, book, etc.), an optional description and an attached file or, in the case of a resource available on the Internet, the link.

- The description of the activity allows specifying in textual form how to perform the activity and what are the tasks that the various actors interested by the activity have to carry out.

- The didactic suggestions section, finally, is addressed to the teacher and concerns pedagogical suggestions and teaching advice useful to anticipate and avoid potential problems, promote better outcomes and prepare for the performance of the activity with the students.

These last two fields constitute the core of an activity. The description of the activity is, in fact, the elicitation of the educational action and represents in textual form the teacher and learners practice (i.e., what to do). Within it, the teacher specifies and coordinates

the relations and interactions between actors, knowledge and resources. The cohesion of the contextual elements with the description of the activity allows interpreting the action as a situated educational event, in other words as a single occurrence of a process characterized by a specific context. In the educational action, in fact, the dynamics involving students and teachers cannot be reduced to a linear series of causes and effects. This makes the educational action a complex system in which regulatory activities performed by teachers are essential to adapt the learning design to the context of each unique and unrepeatable educational event. Starting from this, the didactic suggestions field should stimulate the anticipation of the reflection-in-action, so that teachers can compare their own teaching repertoire with the educational event and find useful solutions to better face the educational activity (i.e., how to do). This anticipation of the reflection-in-action should stimulate the emergence of new affordances and allows refining the educational repertoire of possible solutions to be applied to each educational action. Figure 5.1 shows the atomic structure of a design.

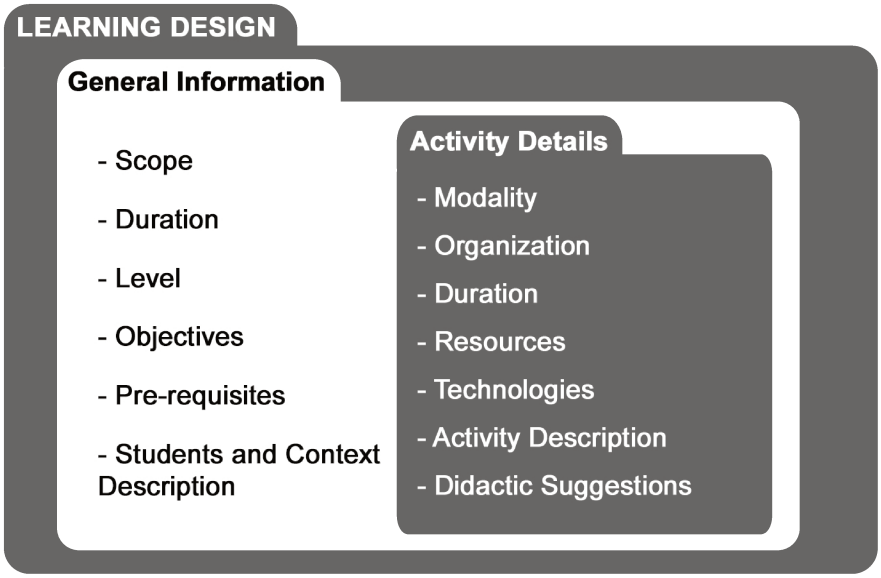

Figure 5.1: Atomic Design Structure

The reflection-in-action also performs a testing function for the design. In fact, with the anticipation of a possible implementation of the activity, the teacher can perceive possible design problems or imagine possible improvements and come back to edit the fields previously completed. In this way we create a design cycle that 1) from the contextual coordinates 2) passes to the description of the activity and 3) leads to the reflection, to eventually 4) come back to change the context and/or 5) the activity description. (Figure

5.2).

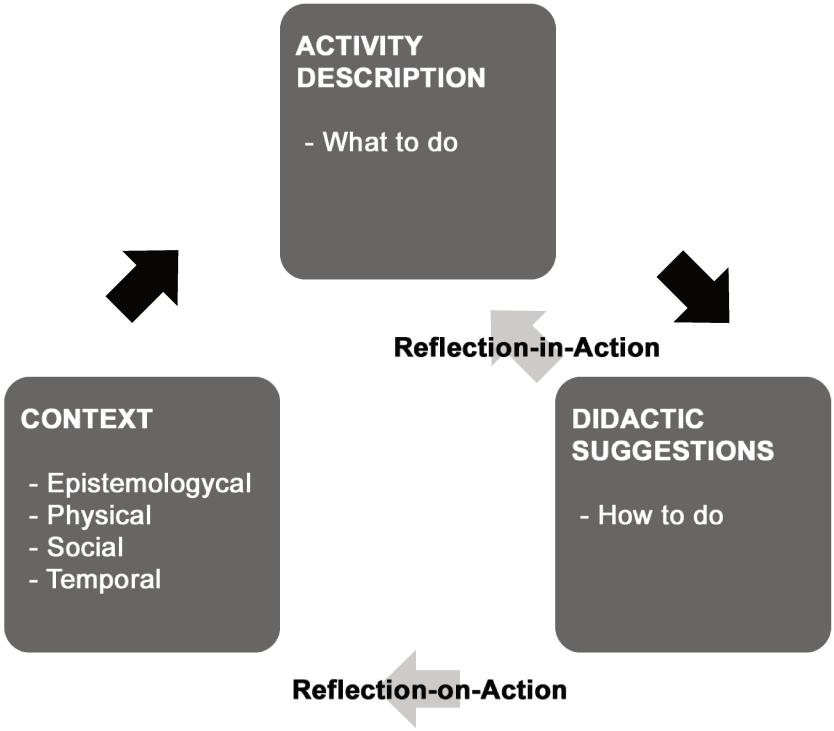

Figure 5.2: Design Cycle

5.6 Design Orchestration

In addition to single activities, it is possible to add a group of activities. A group is a subset of the design, which may have a name and can contain one or more activities organized in a sequential or simultaneous way.

Finally, a design may contain within it one or more different designs. In this way, it is possible to recursively create learning path composed of different scopes. For example, it is possible to create a design of a semester and, within it, organize 3 sequential designs of modules, each lasting two months, and within each one of them, organize various designs of lessons that compose the various modules.

The organization of the elements that compose a design (activities, groups of activities and designs) can be arranged sequentially or simultaneously, allowing the creation of

articulated structures on multiple levels as shown in Figure 5.3

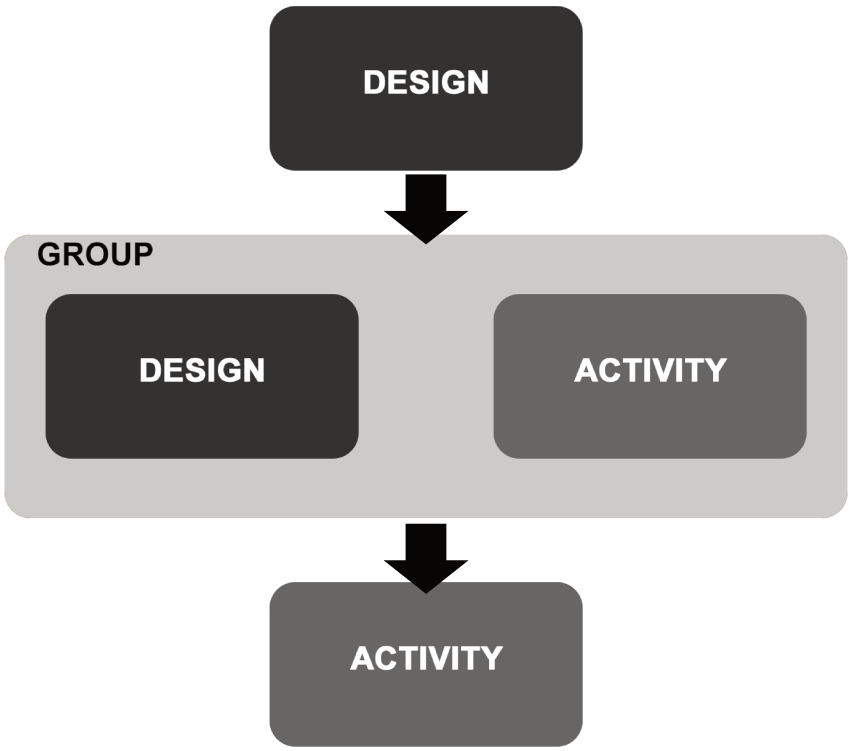

Figure 5.3: Design Orchestration

5.7 Reuse of Designs

The reuse of a design is of fundamental importance, not only to optimize the time required to design, but also for the growth and professional development of teachers. Reuse a design, in fact, means interpreting, modifying and adapting a design to a new, unique and unrepeatable context. This activity of redesign helps the teachers to undertake a double loop of reflection-on action and reflection-in-action. The reflection-on-action is based on the educational action implemented from the initial design and allows the change of the cognitive map of reference, through the highlighting and correcting of errors and problems encountered during the action. The reflection-in-action, instead, allows reshaping the design in reference to the new context, starting a new cycle of design, action and reflection.

For the reuse, therefore, a design is interpreted as a model to start from and where to implement the changes needed to the design be adapted to a new context. This dual activity of reflection-on-action and reflection-in-action should therefore contribute to a

refinement of competences and knowledge on teaching practice, with a consequent development of the teaching repertoire and a critical knowledge based on the educational action. The reuse of designs based on sharing also allows the exchange and comparison of knowledge between novices and experts. Novices, in fact, can inspire their reflection basing on the designs of more experienced teachers, as models for the application of theoretical knowledge to practice and deal with real use cases.

5.8 Usability Exploration

Usability is a crucial factor for the dissemination and reuse of design in education. In fact, one of the major limits reported for the IMS-LD is the complexity of the proposed model and the difficulty for editors based on this specification to achieve good levels of usability [99]. The usability is also crucial for the reuse of designs. If the modification of the elements that compose a design is too onerous or complex, the adaptation to a new context is not very motivating and fruitful. For these reasons, we subjected the LEDITA approach to an exploratory analysis of usability, conducted through an informal test.

The aim of this study was to investigate the level of usability of the process of creation of a design adopting the LEDITA approach, through the reproduction of a design of a lesson of Italian as a foreign language. This design is the same one that was previously used in a usability test of two software for learning design [54]. The design, lasting 90 minutes, was composed of 11 activities grouped into 4 groups, each bound to a phase of the lesson: motivation, analysis, linguistic reflection and final test. The activities were sequential, except for the analysis phase, consisting of two activities performed simultaneously by two different groups of students and a subsequent activity carried out by the whole class. The various activities had different duration and modes of organization, including numerous possibilities for implementation. Participants were 6 members of the InterHAD (Human-Digital Artefact Interaction) research group at the Institute of Computing in the State University of Campinas (UNICAMP)[4]. All participants were doctoral students in computing science, with a thorough background in Human-Computer Interaction and experience in usability testing.

For the usability test, we created a paper prototype representing the interface with the interaction elements for the creation of a design and the details of all activities. For the development of the prototype we have followed the indications given in previous LEDITA research investigations, in order to propose a metaphor closer to the practice and understandable by teachers. Specifically, three buttons for adding an activity, a group or

[4]http://styx.nied.unicamp.br:8080/interhad

a design; a form for adding the general information of a design; a form for adding the details of an activity; a form for adding the details of a resource; a block for displaying a group and a block for displaying an activity (Figure 5.4).

Before the begin of the test, a digital prototype was presented to the participants,

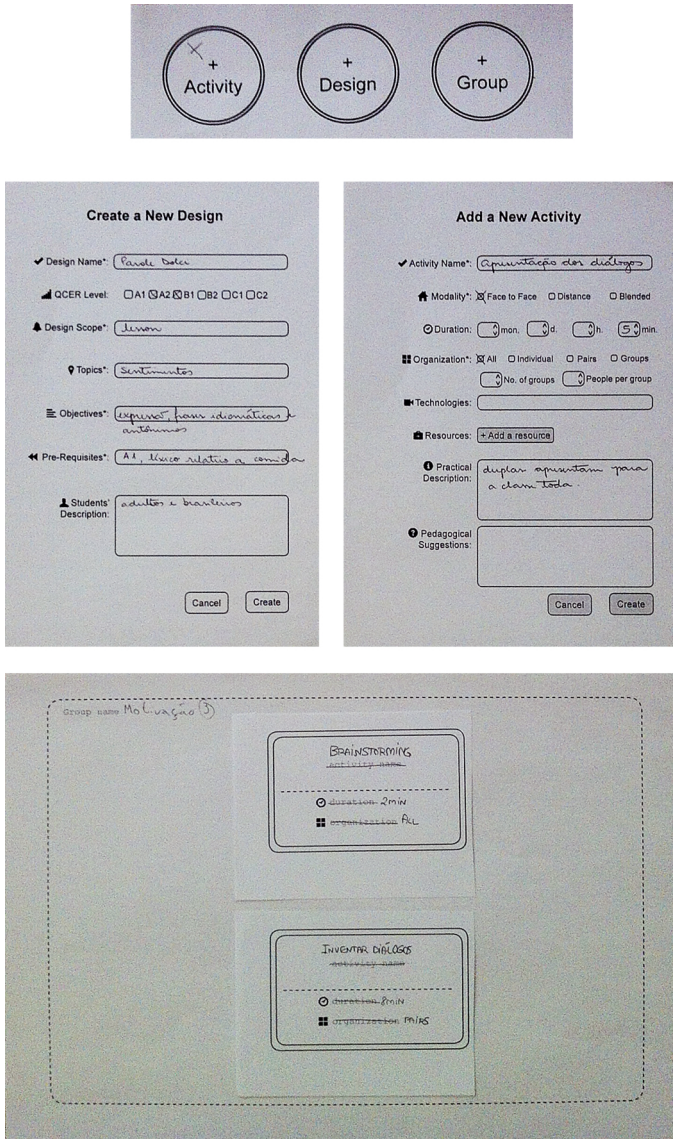

Figure 5.4: LEDITA Prototype for Usability Test

illustrating the various elements that compose a design and a possible visualization of a project already created, but without showing the phase of creation of a design. It was then distributed to the participants a document with the textual description of the project and was asked to use the paper prototype to represent the design through the LEDITA

approach. At the end of the test, was conducted a debriefing activity in which participants shared their experiences and commented on the usability elements of the framework.

The results have shown a good level of usability. All participants were able to reproduce the design without any particular difficulties or problems. The fields and nomenclatures were understandable and did not need further explanation. One of the possible usability problems was found in the creation of groups of activities. In some cases, in fact, the participants began by creating activities and decided to enter activities within a group at a later time. This process showed the need to create a flexible structure in which it is possible to combine activities, groups, and design in a non-linear and diachronic way.

5.9 Discussion

The LEDITA design approach aims to promote the professional development of teachers and the sharing of knowledge between novices and experts through a design process based on the epistemology of practice. The cycle of design, action and reflection is developed through a process of recursive reflection-in-action and reflection-on-action, which allows designing and reusing educational activities in dialogue with a specific context. The starting point of this approach, as proposed by Bailey et al. [100], is the educational problems, not the IMS-LD. The IMS-LD focuses more on the formal correctness and on the representation of the result of the design, rather than capturing designers' knowledge and promote a design process closer to the reality of teachers [65]. From this perspective, the LEDITA approach is characterized as high-level and general [101].

However, unlike the approaches and editors that have followed this same path, the LEDITA approach differs in two fundamental questions. The first is that LEDITA is not intended to represent only best cases, but to serve as a tool for the common practice of teachers. For this reason, LEDITA is not directed exclusively to online education, but also to face-to-face practices. The second point is that LEDITA is not intended to support the design, guiding teachers in the application of educational theory to practical cases, but, on the contrary, starts from the action and from the teaching repertoire of teachers to encourage their reflection about teaching practice.

5.10 Conclusions

Learning Design is a complex practice that requires numerous competencies to face the possible scenarios of educational contexts. The creation and reuse of learning designs de-

mand teachers a critic and reflective view on epistemological contents, physical resources and social interactions.

This paper proposed the LEDITA approach to LD that considers the practice and reflection of teachers as key elements for the design of educational activities. The aim of this approach is to foster an effective use of technology and a professional growth for teachers of Italian as second/foreign language by means of an improvement and a critique organization of their teaching repertoire.

The main characteristic of the LEDITA approach is the double loop of reflection-in-action and reflection-on-action during the design and reuse phases. The reflection-in-action is stimulated, during the elicitation and description of the activities, by the anticipation of the educational event. The reflection-on-action is encouraged, within the reuse of a design, with the modification and adaptation of a design to a new context.

The effectiveness of the approach was explored with a usability analysis that showed a good level of usability and ease of use and understanding. These results are positives and seem to open the perspective of a possible use and diffusion among teachers.

Future works involve the implementation of the approach in a software solution, in order to propose a tool for creation and sharing of designs among a community of teachers of Italian as a foreign/second language.

Chapter 6

Grounding Learning Design on Teaching Practice: the LEDITA Learning Design tool for Italian Language Teachers[1]

6.1 Introduction

Learning Design (LD) is the representation of the teaching/learning process, aimed at creating, eliciting and sharing educational practices among teachers. The object of LD is the definition and orchestration of actors, resources, tools and activities involved in an educational action. As a research field, LD begins to appear in the late 90's [59] and, presently, seems to have reached a certain maturity, establishing itself as a separate and specialized field of educational research [102]. The main aim of LD is to improve the results of educational practices, especially in relation to Technology Enhanced Learning (TEL) [39].

LD has started to become an important and recognized activity among teachers, broadening the restricted group of design specialists [61]. To teachers' perspective, LD is a fundamental process for the reflection about teaching practice and the development of teaching professionalism [97]. In fact, the definition and orchestration of a design allow teachers anticipating the educational action and expanding their didactical repertories with the range of solutions for possible problems. Furthermore, the sharing of knowledge and experience allows teachers reflecting on real cases and building a solid relationship

[1] A. Arpetti, M. C. C. Baranauskas, and T. Leo, "Grounding Learning Design on Teaching Practice: the LEDITA Learning Design tool for Italian Language Teachers", in *2014 IEEE 14h International Conference on Advanced Learning Technologies (ICALT)*, Athens, Greece: IEEE, 2014, pp.706,710.

between knowledge, attitudes and skills, useful to face complex educational contexts.

For the representation and formalization of the designs, the IMS Learning Design specification (IMS-LD) [27] is the current *de facto* standard. However, the IMS-LD suffers a number of usability problems [99] and seems to be educationally complex for programmers and technically complex for educators [103]. Starting from this point, in recent years many LD software tools have been developed, in order to simplify the process of design and to foster the reflection about teaching [52]. On one side, some tools have been developed with a focus on the designs visualization, trying to improve the usability levels of the IMS-LD or proposing an alternative formalism for the simplification of the design representation (ReCourse [104], LdShake [78], LAMS [29], CADMOS [66]). On the other side, some tools have been developed as pedagogical planners, to support the design process among teachers. These tools renounce to the use of a strict formalism for the representation and propose a design guide, mostly based on pedagogical principles (Phoebe [105], London Pedagogy Planner [106], CompendiumLD [107], Learning Designer [108]).

These different interpretations of the LD seem to indicate a certain incompatibility between the various modalities of representation: the formalization of a design facilitates the execution and sharing of projects, but limit the possibility of teachers' reflection; the support to the design process encourages the reflection of teachers, but complicates the interpretation and sharing of designs. Furthermore, both interpretations seem to start from other than educational problems: in the first case, the starting point is the IMS-LD; in the latter, the pedagogical principles. So, the question that motivates this research is: how, starting from educational problems and teaching practice, to conjugate a good usability and the needed flexibility in a software tool devoted to support the reflection about teaching and the sharing of designs?

This paper presents the LEDITA tool, a LD editor developed within a participatory research project [47] for the representation and sharing of designs between a community of teachers of Italian as a second/foreign language. Section 6.2 describes the LEDITA tool, with all the functionalities. Section 6.3 illustrates a usability study conducted with a group of teachers of Italian language. Section 6.4 presents the results of the study and Section 6.5 discusses the results and illustrates the conclusions and future works.

6.2 The LEDITA tool

LEDITA is a free web tool for the creation and sharing of learning designs by teachers of Italian as a second/foreign language (L2/LS). The name "LEDITA" comes from the research project name and stands for "Learning Design for Italian Language" [47]. The aim of this tool is to foster the practice of design between teachers, supporting the reflection

about teaching practice and stimulating the professional growth.

A peculiar characteristic of LEDITA is the attention to usability and interaction elements, in order to facilitate and promote its use by teachers non-specialized in designing. To this end, the development of the software tool is occurred in a participatory manner, with the collaboration of a group of teachers. This methodology allowed better understanding the needs of end users and developing a metaphor and a language closer to the teaching reality [98]. With the purpose to reduce system requirements and respond to the largest number of teachers' needs, the tool is developed as a full web application, executable with just a web browser and an Internet connection. Furthermore, to be useful in various kinds of devices, the application is developed with a responsive design that adapts to different screen sizes and resolutions. Figure 6.1 shows the welcome page useful for log in or create a new account in different devices.

The representation of a design is based on a high-level and general purpose [41] ap-

Figure 6.1: Figure 1. LEDITA responsive design

proach that consists of a general information section for the design and a detailed section for each activity that composes the design (Figure 6.2) [109].

In order to facilitate the visualization and allow teachers to have a better navigation experience, this representation is condensed in a single page view, composed of a left sidebar, reporting the general information, and a main area, representing the contents of the design. This main area is characterized by a double visualization style, one graphical and one textual. As default, a tree graphical representation shows the basic structure of the design, as a design outline with the basic information and organization of the activities. The composition of single activities, group of activities or other learning designs used as parts of the main design is organized with sequential or simultaneous nodes. The teacher

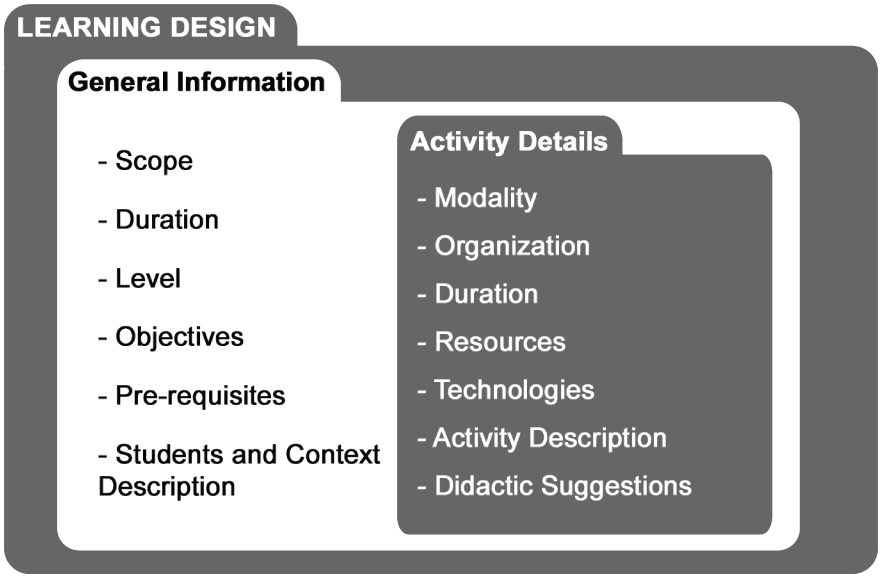

Figure 6.2: Figure 2. LEDITA design structure. (from [108])

can expand every tree node to see all the activity details or navigate to the second tab, where all the activity details are represented together in a textual form (Figure 6.3).

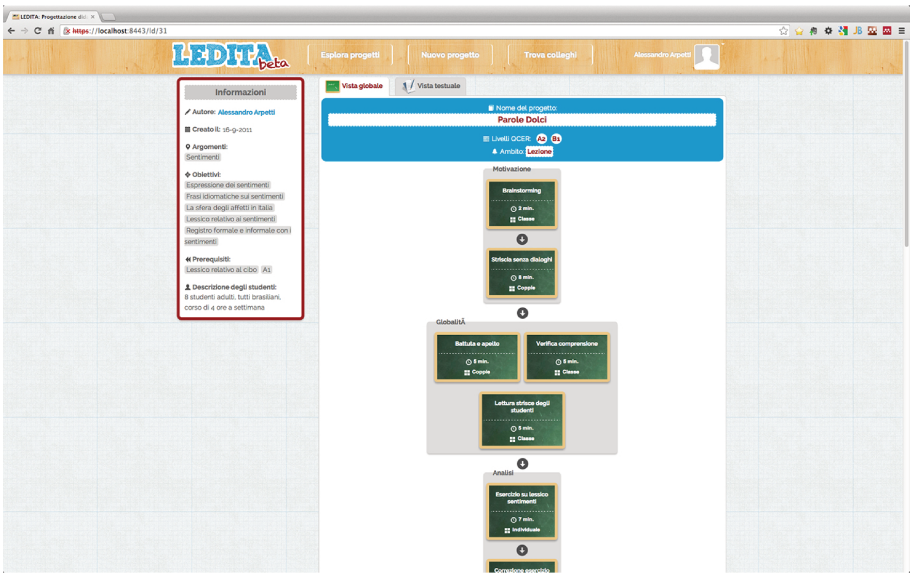

Figure 6.3: Figure 3. LD details page (graphical view)

The creation of a new learning design is guided by a 2 steps recursive path, which from the specification of general information arrives to the definition and the organization of

the activities that compose the design. This guidance concerns specifically the path and not the contents of the design. In fact, the LEDITA approach aims to reach the flexibility needed to represent the real teaching practice, as imagined and interpreted by teachers. To this purpose, no predetermined lists or taxonomies were being defined, but users can fill in the various fields with their preferred values. However, in order to minimize the inconsistency of the data and to offer a possible suggestion to teachers, a typeahead function was implemented. With this feature, when a user digits some characters in the scope, topics, objectives, prerequisites and technologies fields, a list of items already present in the database is showed, allowing the user to choose between them or, if none of them satisfies his/her needs, complete the field with a new item (Figure 6.4).

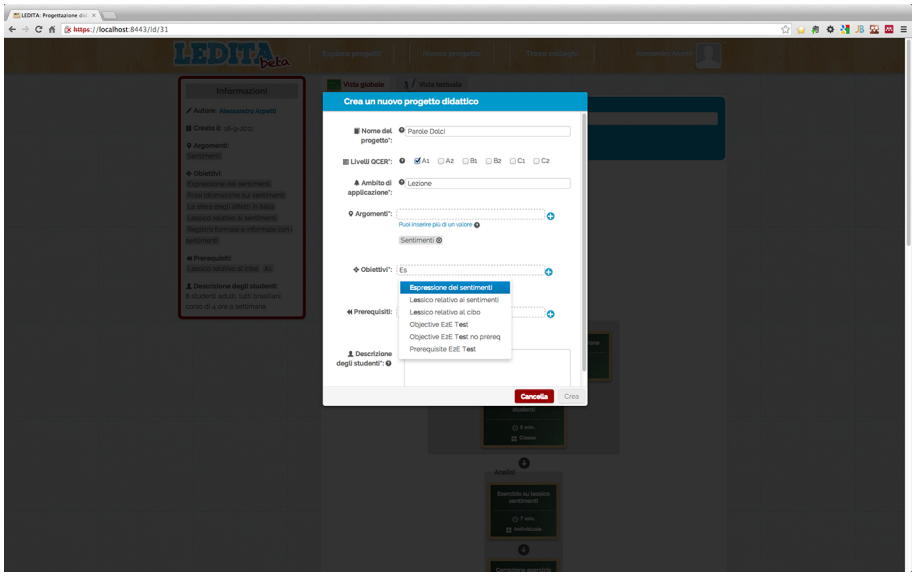

Figure 6.4: LD Creation Modal with Typeahead function

The attention to system flexibility also characterizes the interaction. The single page view permits to control all the elements that compose the design and act a recursive design process, that allows modifying each element at every time. Moreover, in order to promote a better user experience and minimize the possibility of errors, the system interaction is also characterized by automatic saving, drag and drop organization for the tree nodes, popover feedback, help messages and the use of common keyword combinations to edit contents or undo actions. All these features aim to simplify the process of creation and let teachers to feel more comfortable with the system and concentrate their attention to the design activity and the reflection on teaching.

Finally, in order to promote the sharing of designs between teachers, users can explore

and filter the list of all the designs and users recorded in the system and reuse an existing design to create a new one. With this modality, instead of create a design starting from zero, a teacher can modify the information of a selected design and adapt it to his/her context and needs. This sharing modality uses the designs as models that allow economizing time for the creation phase and can foster the emergence of a community of practitioners for the sharing of knowledge and experiences between novice and experts.

6.3 LEDITA Usability Study

A usability test was conducted with the objective to take a holistic look at the LEDITA system and gathering data concerning the process of creation of a learning design and the effectiveness of LEDITA. In specific, the goals of this study were to:

- Assess the overall effectiveness of LEDITA for end-users (teachers of Italian as foreign language) performing a specific task, i.e., the creation of a learning design.
- Identify obstacles to completing the creation of a learning design using the system.
- Verify the efficiency of the system in supporting teachers' reflection during the design activities.

Participants were 5 teachers of Italian as a foreign language who worked in a language school in Campinas, Brazil. All they were Italians and had a specific background and teaching experience. 4 participants had a tertiary education, of which 2 teachers with Master Degree and 2 with Graduation. 1 teacher had a Diploma. All teachers had a Liberal Arts education and 2 of them had a multidisciplinary background. The fields of education were modern languages, psychology, literature and humanities. The training is fairly recent with 1 teachers who have completed the course less than one year ago, 2 between 1 and 5 years ago and 2 for more than 10 years. The professional teaching experience of participants was less than 5 years for 4 teachers and 5-10 years of experience for 1 teacher. Students of their courses were mainly adults. They were asked how was their relationship with technology and all of them said to have a good one. The most commonly used technologies were computer, smartphone and tablet, both in private and professional life. With regard to the software tools, all the participants used Internet, e-mails, an office suite, 3 a graphics program and 4 a video editing tool.

For the test, we conducted 3 45-minutes sessions, 2 individuals and 1 with 3 teachers working together. The aim of this division was to collect data about individual teaching practice and, with the group session, foster the discussion about the process of creation of a learning design. We used a field setting to conduct the sessions, which toke place in the

Italian language school where teachers work. Participants used a PC and Google Chrome browser with a high-speed connection to the Internet. The PCs that the participants use also have installed Camtasia, a software tool for video and audio recorder, and a web camera. Camtasia records what's happening on the screen, the audio of participants and the video from the webcam.

Each session was composed by three parts: 1) a background interview, to investigate the teachers' relation with learning design, 2) the usability test performed with the LEDITA tool, 3) a post-test debriefing to assess the usability of the system and investigate the potential of the LEDITA tool to foster the reflection about teaching practice.

The background interview consisted of 4 questions: 1) Usually, do you design and plan the lessons before the execution with the students?, 2) By your point of view, it is important to design the lessons?, 3) How much time do you devote to design?, 4) Have you ever used a software tool specific for the learning design?

For the second part of the test, participants performed various tasks described in 3 scenarios, using the LEDITA tool. In this exploratory study, we used the thinking aloud technique to allow participants eliciting their thoughts and impressions during the execution of the tasks. We collected data about error and success rates as well as qualitative data about participants' experiences using the system.

The participants' tasks were:

- Scenario 1: Participants logged in the system and viewed the details of 3 learning designs.
- Scenario 2: Participants created a new learning design, added 2 activities and changed the position of these activities. For these tasks, moderator indicated the information to insert.
- Scenario 3: Participants freely created a learning design for 1-hour lesson, using didactic materials of the school and/or retrievable in Internet.

For the post-test debriefing, participants filled out the IBM Computer System Usability Questionnaire (CSUQ)[110]. The CSUQ is appropriate in non-laboratory settings to assess user satisfaction with the system usability. It is a 19-item questionnaire based on a 7-point scale, anchored at the end points with the terms "Strongly agree"for 1, "Strongly disagree"for 7, and a "Not applicable"(N/A) point outside the scale. The CSUQ measures the overall satisfaction score, the system usefulness, the information quality and the interface quality. Finally, participants answered the questions: "Does the use of the LEDITA tool stimulate the reflection about your teaching practice? If yes, which element did you especially helped for the reflection?".

6.4 Results

The background interview highlighted a quite homogeneous relation of participants with the learning design. All teachers usually design the lessons that they will execute with the students, giving great attention to the selection and organization of didactic materials. They use a textual representation and usually organize an outline to guide the implementation of the activities. All participants recognized the importance of learning design, especially for the need to prepare the implementation of the activities and not having to rely exclusively on the improvisation. The amount of time required to design is relevant, even if the teachers have stated that with the experience the time for the design may decrease because there is no need to detail each element. Finally, 4 participants declared that they had never used specific software tools for the design, while only 1 teacher said he had rarely used some software for the learning design. The tools that are normally used to the learning design are a text editor and a web browser to navigate on the Internet.

Concerning the use the system, all participants carried out all the tasks of the three scenarios in the available time. No fatal error has been detected, and help messages allowed the participants to complete each action, as they desired. The analysis of the recordings of the sessions showed a great deal of attention to the organization of the design contents by teachers, leaving in the background the elements of the system. This pointed out that the interaction with the system appeared quite spontaneous, and the language used resulted understandable and clear.

CSUQ results show a good level of usability satisfaction for all the items. The overall satisfaction average was 1,7 (less is better) and all participants confirm a positive experience using the LEDITA tool (Table 6.1).

Participants' comments on questionnaire items report an experience better than

Table 6.1: CSUQ Results (Seven point rating scale. 1 = best, 7 = worst)

	Participants					**Total**
	1	2	3	4	5	**Average**
Overall Satisfaction	1,3	1,6	1,7	1,6	2,2	**1,7**
System Usefulness	1,4	1,5	1,9	1,6	1,6	**1,6**
Information Quality	1,0	1,3	1,8	1,0	2,6	**1,5**
Interaction Quality	1,7	2,0	1,0	2,0	2,7	**1,9**

expected and suggest a possible implementation of tailoring features to allow users personalizing colors and forms of the graphic representation of activities.

With the answers to the last questions, all teachers have stated that the system has stimulated the reflection on their own practice, ”especially in relation to the organization and management of knowledge and content”. They declared that the reflection was ”not caused by a specific element, but by the entire process of design and by the need to elicit all the elements that make up the activities”.

6.5 Discussion and Conclusions

This paper presented the LEDITA tool, a learning design editor for teachers of Italian as a second/foreign language. The aims of this tool are to foster the reflection on the teaching practice and allow the sharing of knowledge and experiences between peers, novices and experts. Usability test showed that these objectives could be achieved with a good usability level and the use of a language and a metaphor close to the practice reality of the teachers' community.

The main characteristics of the LEDITA tool are the flexibility in the creation of a design, based on the typeahead function, and the possibility to use a design as a model for the modification and the adaptation of a design to a new context.

This tool is aimed to support both face-to-face and online learning, and guide the teachers in the creation of a design starting from the teaching practice. In this way, teachers are free to create a design based on real educational problems and refine their didactical repertoire with the reflection on teaching action and the anticipation of the educational event. So, the main question “how, starting from educational problems and teaching practice, to conjugate a good usability and the needed flexibility in a software tool devoted to support the reflection about teaching and the sharing of designs?” seems to have a positive answer.

Future works concerning the test of the LEDITA tool in a large scale and the evaluation of its effectiveness for the professional growth of Italian teachers.

Chapter 7

Conclusions

Educational technology is an extremely complex multidisciplinary field, which lies in the balance between technical rationality and the relativity of knowledge related to the sector of education. The proportion and dialogue between these two components is a key factor for the success of any project that aims to help people learn better. If in the past decades, enthusiasm for the introduction of new technologies and faith in the behaviorists principles have led to a focus on the technical aspect and on the possibility to automate the mechanics of teaching and learning, in recent years the focus has returned to affect mainly the educational and social aspects. The result of this trend has led to observe with a critical eye the naive use of technology and give new impetus to the figure of the teacher. The latter indeed plays a crucial role in organizing, motivating and facilitating the path of learners.

However, this new scenario makes it even more difficult the task of teachers, who need a whole new set of skills to understand, use and benefit from technology in education. Classroom learning based on the book as the main teaching material is now confronted by a learning characterized by the presence of numerous media, open educational resources, free communication and ubiquitous access to information. To ensure that the teacher can take better advantage of all these resources, it is no longer sufficient to rely only on the knowledge acquired and the experience of teaching, but it is also necessary to predict, plan, organize and arrange in detail the educational scenario in which to act.

7.1 Contributions

The contribution of this research relates to the field of Learning Design, defined as a design practice aimed to promote teaching and learning in the contemporary context. Design in order to promote the learning means consider epistemological knowledge, social inte-

ractions, physical resources and the space/time in order to model an educational action for a specific context. Designing in a formal and explicit way entails the production of an artifact, which, once completed its initial function of planning, becomes a documental resource of the educational action. In this evidence, it is possible to ground the experience, exchange and dialogue among peers and optimize time and resources for the design of future plans.

The main contributions of this work intertwine the theoretical level of understanding and development of the conceptual body and the practical level of implementation of the proposed solution. In detail, this path is articulated with the definition of the DAR3T design model, with the proposition of the LEDITA design approach and, finally, with the development of the LEDITA tool.

The DAR3T model allowed to focus on the design aspects related not only to the students and learning, but also to the teachers and the possibility to use the design for their professional growth. The reference to Schön's epistemology of practice [23] also helped to link design to reflection, in and on action, as fundamental practice for cycle of design, use and reuse of a learning design. This first theoretical step has characterized the LEDITA project, basing it on the teaching practice and differentiating it from the scenario of current LD research, which is mainly inspired by the research for a formalization and a definition of a sufficiently expressive representational language, or by the use of principles and pedagogical theories to support and guide the teachers' design.

The basing on the teaching practice led to the definition of the LEDITA approach, characterized by reference to the teaching context as a support for the creation of a design. Refer to practice means to refer to unique events, characterized by the combination and the dialogue of the epistemological, physical, social and spatio-temporal spheres. The highlight of the context and of all the elements that compose it allowed then to isolate and bring out a dual characterization of design that, at the moment in which it is created, it becomes anticipation of the educational event and allows to implement the reflection-in-action. The description of educational action and the proposition of didactic suggestions arising from the reflection-in-action, finally become the cornerstone on which to base the reuse and sharing of designs. From sharing experiences among peers or from the reflection on the educational action previously implemented, it is possible to start again for the adaptation and modification of the contextual coordinates needed to breathe new life into a learning design.

Finally, the development of LEDITA tool has actualized the conceptual framework, by focusing on flexibility and ease of use. The flexibility is reflected in the dual graphical and textual representation, in the possibility to define the scope of the design, in the opportunity to organize designs in a recursive manner, in the ease of organizing and editing activities, and in the possibility of using a design as a model by changing only the desired

elements. Usability, instead, is found in all the elements of the software tool, going beyond ease of use and learnability and investing the understanding and meaning that the entire research path has focused in the implementation of the final solution.

The achievement of good levels of usability and understanding of LEDITA tool by teachers has shown that the research path succeeded to make familiar the formalization and explicitness of the design practice, eliminating the elements of complexity and understanding that might undermine the dissemination and use by teachers. This result was favored by the close collaboration with teachers and the use of semio-participatory practices, which allowed to get closer to the reality of teaching and reveal the understanding of their practices, values, needs, difficulties and aspirations. In this manner, it was possible to overcome the dichotomy programmers / educators and achieve the balance necessary to the success of Educational Technology.

Finally, the carried out work has responded positively to the initial research question through the definition of an approach and the implementation of a software tool close to teachers reality and able to promote the use and dissemination of LD between teachers non-specialized in design. The participatory practices used to design the system allowed defining a language and an interaction meaningful for teachers, who can create, with a big level of flexibility, learning designs with multiple levels of granularity. The tool is useful for both face-to-face and distance learning and the design cycle implemented by LEDITA allow the reuse of a LD simply modifying the information useful to adapt the design to the new context.

Designing with the LEDITA tool also allows the development of competences and professional growth, through reflection-in-action and expansion of the didactic repertoire implemented at the design stage, and through the reflection-on-action and critical review of their professionalism, implemented by means of the sharing and adaptation of a design to a new context.

7.2 Future Works

The development of the LEDITA tool represented, gathering theoretical and practical contributions, the closing of a first cycle of analysis, design and evaluation of the proposed solutions to the initial research question.

From the perspective of the iterative cycles of research suggested by the adopted methodological approach, future works can be:

- large-scale validation of LEDITA tool;
- reflection on professional growth related to prolonged use of LEDITA tool by tea-

chers;

- refining and optimizing the design model through critical reflection of the results related to a greater number of users;
- the study and development of additions to LEDITA tool in order to facilitate the interaction between teachers and the creation of a community of practice related to the designs sharing;
- investigate and develop modes of interaction for the co-design by a group of teachers at a distance;
- investigate the possibility of integration of designs created with LEDITA tool with Learning Management Systems for direct import and implementation of designs;
- study possible solutions for opening the model and the tool to other disciplines in addition to Italian as a second/foreign language, for which the software has been created with some specific fields, e.g. "language level".

Finally, research results have expanded the horizon of Learning Design, including the teaching practice to the formalization of the design specification and to the guide of pedagogical principles. A further expansion of the research field could involve the inclusion of students to the design process, in order to promote the development of practices of participatory design and co-design.

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