DEVELOPING A USER ORIENTED DESIGN METHODOLOGY FOR LEARNING ACTIVITIES USING BOUNDARY OBJECTS

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ABSTRACT

International Standards in High and Open and Distance Education are used for developing Open Educational Resources (OERs). Current issues in e-learning community are the specification of learning chunks and the definition of describing designs for different units of learning (activities, units, courses) in a generic though expandable format. Developing educational content, courseware and pedagogical tools to support Subject Matter Experts in their educational practice is a challenging task for the Instructional Design Field. This paper's aim is to introduce a user oriented design methodology for Open and Distance Learning (ODL) activities orchestrating pedagogical tools so as to develop e-learning activities in Hellenic Open University (HOU) by the use of Boundary Objects (BOs).

KEYWORDS

Participatory Design, Communities of Practice, Boundary Objects, Learning Design, Design Research, Empirical Research

1. INTRODUCTION

With the advent of technological tools and a plethora of learning theories provided, course designers and Subject Matter Experts need guidance in producing learning activities which take account the new reality (complexity of technological tools provided, variation in students' profile, culture of subject domain) and maximize the potential technologies offer. The design problem arising out of that educational reality is about capturing and representing practice in Higher Education (HE) institutions and providing "scaffolding" or support in practitioners for designing learning activities which draw on good practice and make effective use of tools and pedagogies, not necessarily in a linear mode. Sharing and reuse of educational material needs to be based on these attributes of learning design: a) to be based on sound pedagogical principles, b) to promote sharing of expertise, c) to support the community through available support services (Walker and Masterman, 2010).

Learning Design is not understood uniformly, with perceptions ranging from misconstruction to highly developed understanding: teachers need technical training on how to use the tools but also they need training to help them understand how to use the tools to achieve pedagogical goals (Bower and Wittmann, 2010). In this case basic research aim has been to involve practitioners in the design of learning activities and capture their contribution on the structures' schematization of Open and Distance Learning activities followed by the selection of the appropriate educational content. The activity definition selected in this research approach has been the one viewing learning activities in relation to the design process "as a specific interaction of learner(s) with other(s) using specific tools and resources, orientated towards specific outcomes" (Beetham and Sharpe, 2007). The rationale has been to structure small Communities of Practice (CoPs) as a springboard to further expand the future development of online larger communities, based on models which offer "scaffolding" into the practice of sharing.

Most of the current instructional design models are spin-offs or variations of the ADDIE instructional design model (Peterson, 2003). However, one commonly accepted improvement to this model is the use of *Rapid Prototyping* (Fischer, 2011): the idea of receiving continual or formative feedback while instructional materials are being created, catching design problems while they are still easy to fix. Springboard of the design rationale of the specific research scheme has been not to use from the early design stages a specific Instructional Design model, but use instead a methodology open for allowing the emergence and iterative development of activity schemata and pedagogical tools under development. A *Learning Design* (Koper, 2006) approach has been adapted as a) a means of eliciting designs from academics in a format that can be tested and reviewed by developers, b) a means of reusing designs of activities, c) a means of tentatively supporting practitioners through the process of creating new learning activities . As Conole (2010) has stated the key facet to adapt and reuse existing learning activities has been to abstract the essential and transferrable properties of learning activities in generic schemata, expandable however in more complicated forms. As a means to achieve that we have selected the Participatory Design (PD) approach as an instructional strategy technique and the use of *Mediating Artifacts (* MA, Conole 2010) in a Communities of Practice (CoPs) format as means of developing learning activities' structures and generic pedagogical tools, used by the Hellenic Open University's practitioners. There has been an effort to ground Instructional Design Theory (IDT) in educational practice, to examine the profession as a living, changing and growing practice capturing elements and aspects of Tutors' educational experience in shaping learning activities' structures and pedagogical tools under development. In providing an optimum learning experience we chose a) to continually evaluate the learning media for usability and effectiveness, and as early as possible, b) to immediately revise, rewrite, recreate, or add to the learning media in a cyclic pattern. Basic aims have been to understand the mechanisms of interaction between (i) the world of design and users and ii) between loops of co design and loops of uses so as to produce guidelines of an user oriented methodology for designing and developing learning activities and supportive pedagogical tools which provide scaffolding to practitioners. This paper is structured as follows: a short, critical presentation of the Learning Design approach is developed followed by the basic characteristics of Rapid Prototyping and Boundary Objects which structured the basis of the proposed methodology. In the proceeding sections a description is presented of the research schema implementation and basic components of the first generation pedagogical design followed by preliminary data comprising an example of the methodology introduced. Conclusion is presented in section 4.

2. DEVELOPING A USER ORIENTED DESIGN METHODOLOGY FOR E-LEARNING ACTIVITIES

2.1 The Learning Design (LD) Approach

The term Learning Design (LD) has been inextricably linked with the development of IMS-Learning Design specification (http://www.imsglobal.org/learningdesign/index.html) aiming at providing a means of formal representation and reuse of learning sequences. Since then LD has been broadly used by researchers and developers in course design and there has been a shift from content creation and presentation to focus on learning activities. The ADDIE model has been dominant and profoundly influential in forming educational practice in the terms of designing educational courses and adaptive systems supporting these (Conole and Retalis, 2010). However, it has been criticized of a) not being necessarily leading to the best instructional solutions, b) not providing solutions in a timely and efficient manner, c) not taking advantage of technologies that allow for less linear approaches to Instructional Design (ID) such as Rapid Prototyping (RP). It has been argued that its application in real educational settings is time consuming and produces boring courseware (Dick et al, 2011) .

2.2 Rapid Prototyping (RP) and Boundary Objects (BOs)

The Rapid Prototyping (RP) process involves quickly developing a prototype product in the very early stages of the instructional design project and then going through a series of rapid tryouts and revision cycles: this design technique has been advocated as a means of producing quality instructional materials in less time than is required when more conventional instructional design techniques are employed. Rapid prototyping models involve learners and/or Subject Matter Experts interacting with prototypes and instructional designers in a continuous review/revision cycle (Fischer et al, 2011, Dick et al, 2012). Developing a prototype is practically the first step, while front-end analysis is generally reduced or converted into an on-going, interactive process between subject-matter, objectives, and materials. Basic criteria for implementing this process have been a) promoting the discussion between Practitioners, Instructional Designer, Learners in a focused way, by concentrating on the facts and the results ,rather than *a priori* selected and defined ID models and learning theories, b) developing shared understanding among the HOU practitioners and instructional designer involved in the project so as to build trust and create a common language between fields, c) making the design and development process open to new emerging ideas, d) making the design open to emerging needs from test and evaluation phases, e) focusing on pedagogical design (teaching) instead\of course materials preparation and technology. The rapid prototype creates an early iteration loop that provides valuable feedback on technical issues, creative treatment, and effectiveness of instruction.

CoPs consist of practitioners who work as a community in a certain domain undertaking similar work (Fischer, 2011). A community of practice has many possible paths and many roles (identities) within it (e.g., leader, scribe, power-user, visionary, and so forth). *Boundary objects* (Fischer, 2011) are externalizations of ideas that are used to communicate and facilitate shared understandings across spatial, temporal, conceptual, or technological gaps: as intermediary productions, they result from interactions between designers' and users' world, based on rules identified by the designers: utilization of these artifacts in the users' activity constitutes an opportunity for testing the hypothesis of designers, revealing their consequences and possibly enriching or shifting them. These objects incorporate the knowledge coproduced during the design process: uses in real practice improve the validity of this produced knowledge. Boundary objects play an important role in the emergence of both socio-technical compromises and mutual learning processes. In order to play this role three characteristics are essential: a) *robustness:* boundary knowledge incorporate all the knowledge (Theoretical and Actionable) produced during the design process and allow for their interactions, b) *openness:* the use of generic, plastic, reconfigurable objects allows for their adaptation to different purposes and needs, c) *simulation/visualization capacity:* visual representations as used in this case are a basis for practitioners' –designers' communications and enrich the knowledge creation process. End User Development (EUD) is necessary as it is impossible to design artifacts (software systems, learning environments) at design time for all the problems that occur in use time.

3. IMPLEMENTATION

Research shows that tutors prefer to use models as an inspiration for creating learning designs that suit their own style and context rather than simply copying the shared samples (Walker and Masterman, 2010) . A major obstacle to teacher adoption of learning designs is an insufficient level of pedagogical understanding required to make use of resources (Cameron, 2010). Basic aim has been to capture HOU Lecturers' experience of educational practice and allow for emergence of reusable concepts and educational content in Micro level (activity) to Meso level (module) and Macro level (Thematic Unit) of (4) Thematic Units. (14) HOU Lecturers participated in the conducted research, as well as (200) adult students of both Undergraduate and Postgraduate Courses. Focus Groups sessions have been used as a context for supporting the design of learning activities and actual testing of LAMS (http://lams.org) learning activities in adult HOU students has taken place during October and November of 2012. Basic pedagogical guidelines have been adopted to produce generic learning designs through the use of pedagogical planning tools: generic activity templates have been produced and educational content in the form of Learning Objects has emerged out of the process. Basic aim has been to allow for iterative cycles of design with in parallel development of both pedagogical planning tools used and activity schemata produced by the HOU Tutors. The designed activities have been oriented towards learning trends such as assessment based learning, cooperative learning, self regulated

learning (Beethan and Sharpe, 2007): their generic pedagogical characteristics emerged out of the tutors' design, they are however expandable in richer formats and more complex forms. The structural components of the methodology used have been intentionally selected to apply in an array of subject domains: HOU numbers (203) Thematic Units in (4) Schools: Humanities, Social Sciences, Sciences and Technology, Applied Arts. The LAMS platform has been used experimentally in order to assess students' and teachers' attitudes on using it as an ICT tool in their educational and learning practice. However, the approach implemented can be mapped in other LMS platforms such as Moodle. Whereas LAMS is designed to operate more at the level of individual lessons, Moodle is designed to structure courses (Bower & Whittmann, 2011). LAMS more tightly defines the sequence with which resources and activities are accessed whereas Moodle offers more student control over the order in which resources and tools are used. There are limitations in each case, however there is also the ability to implement Moodle learning activities within LAMS. The produced representations out of the design process have been a) learning sequences in LAMS, b) conceptual maps of the educational content used, c) paper artifacts representing the structure of learning activity, d) verification of the structure of the pedagogical planning tool designed and used, the Design for Pedagogy Tool (D4P). Practice focused representations have been used (eg case studies, lesson plans and patterns), conceptual representations (eg mind maps), abstract representations eg (vocabulary) (Conole, 2010).

3.1 Methodology Applied

E-Co-Me T Lab (http://www.eeyem.eap.gr) is a supporting organization of HOU courses providing innovations in design of educational methodologies and educational content production. A design research methodology (Fischer et al, 2011) has been implemented, involving HOU Lecturers and the E-Co-Me T Lab ID Team in producing mediating artifacts for (4) TU of HOU that have been used so as to design and develop learning design activities using LAMS. The design research approach has been used so as to form prototheory, explore concepts and processes so as to further develop in the future the initial design in iterative cycles (Fischer, 2011). Practitioners used a) flashcards to arrange the infrastructure of a Learning Activity in LAMS, b) diagrammatic representation of the educational content used for the activity design, c) Bloom's taxonomy so as to produce expected Learning Outcomes (LOs) for their activities. Basic steps of the activity design process are presented in Figure 1:

Figure 1. Basic steps of the activity design process

The design research methodology supported the use of ethnographic practices: qualitative data, collected from (2) Focus Group (FG) sessions aimed at revealing the connection between what and why, uncovering concepts, relationships and processes while a questionnaire has been used for evaluation of both LAMS designed learning activities and FG sessions. Both activities' paper artifacts and LAMS learning sequence archetypes have been used as boundary objects in further development and filtering of the learning activities. Generic templates of learning sequences and pedagogical tools further expandable have been developed so as to facilitate learning design in HOU. The design criterion of the activity template has been to use a generic form so as :a) to motivate lecturers to contribute to production of new material and increase participation, b) to support and encourage the development of learning examples, and emerging conceptual models. Basic aim has been to encapsulate critical pedagogical properties of the design: theories of learning have been reflected to designed activities. Grouping Learning Design resources' aspects by discreet discipline domains is expected to allow for simultaneous investigation on what works within domain using specific frameworks and explore the relationships between the domains.

3.2 Preliminary Data-First Generation Pedagogical Design

Basic phases of the User Oriented Design Methodology are i) limiting the design problem by analyzing the specific problem to solve, ii) building a theoretical support by building construction principles and design rules, iii) building archetypes by the use of boundary objects as a result of interaction between HOU practitioners and instructional designer, iv) experimentation by two complementary phases and forthcoming scenario based evaluation of the boundary objects produced, v) the adoption-adaptation process which progressively spread and transform the organizational context. These are presented in the following figure:

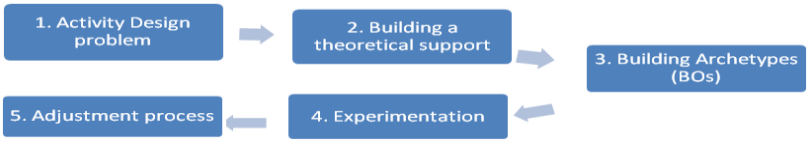


Figure 2. Basic phases of the UO Methodology

Boundary objects result from compromises and negotiations between designers and users, they allow the work of mutual adaptation i.e the co evolution of designers' and users' world. An important aspect stressed by most authors is the careful planning of all ODL activities from a pedagogical, organizational, financial, managerial and administrative point of view (Conole, 2010). The types of Boundary Objects that have been used are presented in Figure 3:

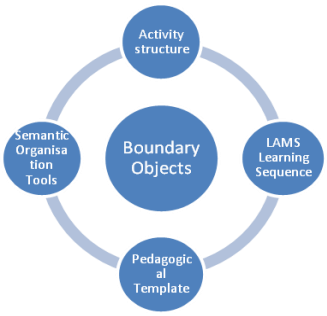


Figure 3. Types of Boundary Objects used

As main objectives of the proposed methodology have been:

- Classification and reuse of ODL concepts and content in HOU educational curriculum
- Integration and authorized exchange/dissemination of information and knowledge
- User friendly design i.e. usage requires only basic IT skills
- Extendibility and flexibility of educational content used
- Design and implementation of learning modules using existing educational content and concepts without excluding the emergence of new educational material
- Creating learning chunks for using LOs
- Based on open standards and existing LMS technologies

Object Based Learning (OBL) has been selected as compatible with HE standards and amiable to already produced educational content and already designed Learning Objects of HOU courses. Hierarchical structure of major and minor learning objectives in learning activities supports a) structuring of learning experience from simpler to more complex forms, b) emergence of important and less important concepts of educational content and principles in design activities, c) relatively easy transition from Micro level (activity) to Meso level (module) and Macro level (Thematic Unit). Using reusable concepts and educational content of various Thematic Units forms a modular curriculum under which theory and practice are closely interwined and less important aspects of educational content are left behind, providing space to innovation of educational content used. The design strategies developed in the scope of the framework that has been described earlier have been the following:

- Define learning outcomes in Micro-Meso-Macro level
- Structure Activities-Units-Modules according to learning outcomes set in specific criteria by HOU Lecturers
- Use ODL Standards to design learning activities, supported by generic but flexible instructional design tools
- Set Expected Learning Outcomes but also allow for emergence of non Expected Learning Outcomes
- Allign LOs with Assessment tasks and use Learning Outcomes as a springboard for emerging Learning Objects
- Use both students and teacher profile for the learning and teaching process: design for diversity
- Set criteria for learner performance: specify how students achieve knowledge
- Encourage deep level learning: from description to explanation
- Encourage learner's selection: choosing between focus of learning experience
- Provide educational material which gradually becomes more difficult for the learner to tackle with
- Allowing for emergence of policy changes in organizational settings
- Focus on both concepts and skills

Textual and content mapping representations are probably the most common ways in which teachers think about their designs (Conole, 2010). However, in this case hierarchical semantic organization tools have been used in the format of concept maps (expandable however in ontology schemata) and pedagogical principles generated in the (4) learning activities. Pedagogical tools initially designed and developed have been pilot tested in HOU Practitioners, process which actually confirmed the initial structure of these. In a design research scope selected (Fischer et al, 2011), there has been a process of reshaping parameters of the pedagogical tools used, extending their use in learning theories such as self regulated learning, cooperative and constructivist learning. The design components, influencing the first generation pedagogical design which emerged out of the implementation of our methodology are presented in the Table 1. Table 2 presents produced combinations among Lams Learning Activities, Learning Outcomes and Learning Object Types:

Table 1. Design components influencing first generation pedagogical design

Components Influencing Pedagogical Design	Category I	Category II
Learning Outcomes	**Bloom's taxonomy**	Types of LOs
Learner Characteristics	**Prior Knowledge**	Learner's Profile
Structure	**Activity components**	Conceptual Map
Information Presentation	**Activity structure**	Tasks
Learning Environment	**LAMS tools**	Support & Scaffolding, Assessment

Table 2. Produced Combinations between LAMS Learning Activities, Learning Outcomes and Learning Object Types

LAMS Learning Activity	Learning Outcomes	Learning Object Types
Message Board Activity	**LO1, LO2, LO3, LO4, LO5,LO8,LO9, LO10,LO13,**	Text
Share Resources	**LO5**	Video
Report Submission	**LO5**	Exercise
Questions and Answers	**LO5,LO6,LO11,LO12**	Multiple Choice Question

In Figure 4 a snapshot of LAMS Activity (1) and the conceptual map in Thematic Unit (TU) ICT31 is presented:

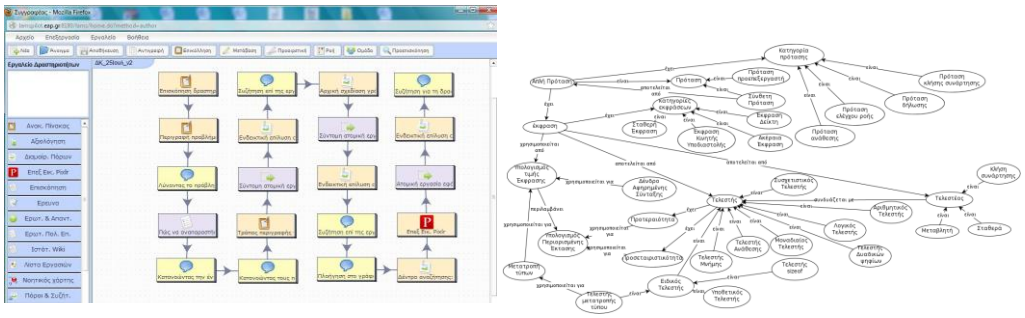
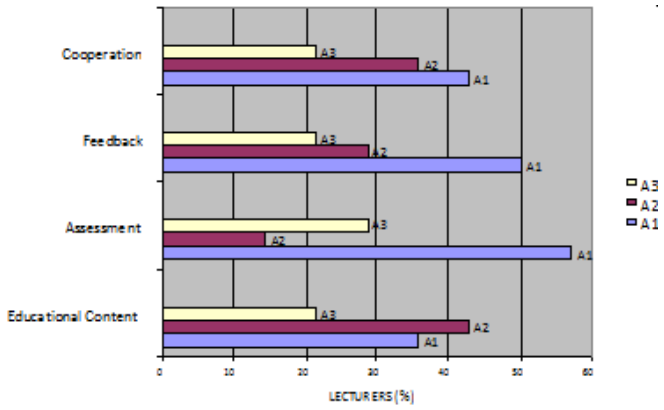


Figure 4. Snapshot of LAMS Activity (1) in HOU TU ICT31and the conceptual map of the educational content

As a result of the proposed methodology the following data have been produced: (4) structures of learning activities using LAMS presenting however a variety in designed Learning Outcomes and frequency of LAMS tools used under different pedagogical underpinning rationale. Interaction of the research team with HOU lecturers according to specific research agenda revealed important issues regarding the quality of educational material used in actual HOU courses and HOU Lecturers' reflection on its use in educational practice. The paper prototypes and digital archetypes have been evaluated and their structure confirmed during the pilot study period. Formative evaluation has been conducted using questionnaires on conducting Focus Groups and use of designed LAMS activities. These have provided feedback on the design effectiveness of tools used and allowed us reach the conclusion that the proposed research scheme, its products and their basic operation has been understood and accepted for use by HOU Practitioners. Table 3 presents Lecturers' percentage on attitudes regarding using basic categories of LAMS Activities (Educational Content, Assessment, Cooperation, Feedback) in (3) LAMS Learning sequences that have actually been tested to HOU students:

Table 3. Lecturers' attitudes on usefulness of basic categories of LAMS tools used in (3) Activities



4. CONCLUSION

The objective of this paper is to briefly present and propose basic characteristics of a user oriented methodology for designing and developing e- learning activities using LAMS. Our methodology provides new insight into achieving customization of e -learning activities and pedagogical tools in organizational contexts. This methodology is based on the following characteristics: a) the utilization of artifacts in the practitioners' activities and educational practice as an opportunity for testing, enriching and shifting them, b)

an iterative cycle process: building intermediary productions at each loop allows to articulate the multiple rationalities existing in an educational network and this articulation requires substantial labor of translation, negotiation, debate, triangulation and simplification, c) using boundary objects as mediators for the co evolution of both designers' world and practitioners' world. We have argued that the construction of successive boundary objects and their uses in real situations allows for close interaction between scholars and practitioners, an emergent process of arbitrage in which practitioners and instructional designers engage with one another to produce together the solutions and both theoretical and practical knowledge in the field of management. Future work includes an iterative phase of testing the revised LAMS Learning Activities in HOU students, expansion of generic pedagogical tools used and further process and analysis of data collected. A professional framework needs to be put in place for two purposes: a) to educate users about learning design based on pedagogical principles, b) to facilitate adoption in alignment with pedagogical goals set at an institutional level. The development of the pedagogical framework needs time and involvement of participants from various jurisdictions so as to create rich pedagogical structures that can be used as a starting point for localized adaptation.

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