

Case-based Learning in VTLE: An Effective Strategy for Improving Learning Design

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Abstract

This article presents preliminary research from an instructional design perspective on the design of the case method as an integral part of pedagogy and technology. Key features and benefits using this teaching and learning strategy in a Virtual Teaching and Learning Environment (VTLE) are identified, taking into account the requirements of the European Higher Education Area (EHEA) for a competence-based curricula design. The implications of these findings for a learning object approach exploring the possibilities of learning personalization, reusability and interoperability through IMS LD, are also analyzed.

1. Introduction

The Bologna Process is bringing universities into line with the EHEA. One of the requirements of this process is to develop competency-based curricula. The Tuning project has defined a competency as “a dynamic combination of attributes – with respect to knowledge and its application, to attitudes and responsibilities – that describe the learning outcomes of an educational programme, or how learners are able to perform at the end of an educational process.” (González & Wagenaar, 2003, p. 225).

This definition is similar to that proposed by The International Board of Standards for Training, Performance and Instruction (IBSTPI)¹ and used by Richey, Fields and Foxon (2001) to establish the core competences for instructional designers. They define a competence as “...a knowledge, skill, or attitude that enables one to effectively perform the activities of a given occupation or function to the standards expected in employment”. (p.31).

The design of a competence-based curriculum entails rethinking and redesigning programs and courses, and stimulates the application of social-constructivist pedagogical approaches that are learner and community-centered. . In an analysis of the research literature, Bonwell and Eison (1991) suggest that “students must do more than just listen: They must read, write, discuss, or be engaged in solving problems. Most important, to be actively involved, students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation. Within this context, it is proposed that strategies promoting active learning be defined as instructional activities involving students in doing things and thinking about what they are doing.”(p.2)

One of the teaching and learning methodologies that might better fit this scenario is the case method.

¹ IBSTPI: The International Board of Standards for Training, Performance and Instruction: <http://www.ibstpi.org/competencies.htm>

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2. Theoretical Framework

The case method was first implemented in 1871 by the Harvard Law School and has been in use in Higher Education for over a century. Since then, the method has gained advocates from different academic disciplines such as in business, medicine, administration, social sciences, arts, engineering, agriculture, politics and social development. A case is a story that explains “real (or realistic) events or problems so that the students experience the complexities, ambiguities, and uncertainties confronted by the original participants in the case. As they ‘inhabit’ a case, students must tease out key components from the real messiness of contradictory and complicated information (Golich, V. et al., p.1).”

In expert literature we find case-based learning, case study, case-based reasoning and case method as the most commonly used terms to explain case writing, teaching and learning. Kowalski (1995) differentiates between case study and case method: the former corresponds to a general description of a situation while the latter has specific reference to using the case study as a teaching paradigm. In another dimension, cases are also related to problem-based learning or problem solving, not as the same strategy but as a resource or element that is used as a story.

Jonassen and Hernández-Serrano (2002) define the concept as case-based reasoning in terms of using stories to support problem solving; “stories are the most natural and powerful formalism for storing and describing experiential knowledge that is essential to problem solving. The rationale and means for analyzing, organizing, and presenting stories to support problem solving are defined by case-based reasoning. Problems are solved by retrieving similar past experiences in the form of stories and applying the lessons learned from those stories to the new problems.” (p.65). In the same article, the authors mention the need for new methods for task analysis and models for designing instruction because the emphasis on problem-based learning in the instructional design field has increased in the past years.

Also, Nelson’s (1999) approach is interesting, because one of the main competences that we want to promote through the case method is that of working collaboratively. For Nelson, the use of cases and problems allows teachers to offer richer and more realistic learning experiences: “...an important feature of the CPS (collaborative problem solving) instructional theory is that it supports the most powerful types of problem-solving activity that learners can engage in – those that are based on their own natural collaborative processes.” (p.245)

For the purpose of our research we define “case-based learning” (CBL) as an instructional strategy that uses case study as a resource and “case method” as the learning scenario describing how learners and instructor interact.

In this sense, the theoretical discussion also examines the relationship between the case-based reasoning (CBR) model and the Problem Based Learning (PBL) model.

According to Eshach and Bitterman (2003, p.491) “CBR indicates that the knowledge source one uses while solving a new problem includes not only generalized rules or general cases, but often a memory of stored cases recording specific prior episodes. CBR enables the reasoner to recommend solutions to problems quickly and to propose solutions in domains that are not completely understood ...”.

Most professors using case study describe it as a descriptive document, delivered as a narrative that is based on a real situation or event. The case tries to facilitate a balanced relationship between the multidimensional representation of the context, its participants and the reality of the situation.

Smith (1999) enumerates the main features of a case: “(1) a context-based, relevant and relatively realistic scenario; (2) a challenging but not too frustrating problem, task, or situation; (3) a somewhat open-ended problem or situation that requires careful formulation and listing of assumptions; (4) a problem or situation that motivates students to explore, investigate, and study; (5) a problem or situation that encourages or requires interaction among students, between students and faculty, between students and outside resources; and (6) a problem that requires addressing the integration of broader aspects, including technical, economic, social, ethical, and environmental.”(p.2)

Different types of case-based learning have been classified using different criteria. Hebert et al. (2005) elaborated a typology based on learning objectives summarizing the work of Van Stappen (1989), Guilbert and Ouellet (1997), Proulx (1994) and Martínez and Musitu (1995). He distinguished between the methodological purposes these writers followed, and also outlined a number of internal guidelines for teacher training, such as those from UOC, which differentiate between closed (restricted answers) and open cases (multiple solutions); or those from the Instituto Tecnológico Superior de Monterrey (TEC), which focuses on the case subject, its basis in reality, its subjective/objective possibilities and the values it represents (DIDE, 2001).

Another approach of case-based learning is the use of “transfer” as a capability to reuse knowledge and skills in a context that differs from the one in which they have been acquired. Haack and Mischke (2005) follow this line; “Case and problem based learning environment support learners both, in the active process of self-directed learning as well as in the consolidation of new knowledge. Especially case-based learning fosters the usage of transfer by providing appropriate stimuli to recall previous knowledge”(p.1). Mauri, Coll, Colomina, Mayordomo and Onrubia (2004) describe two main approaches: one which, according to the learning objectives, promotes the capacity of analysis, identification and description of those key aspects constitutive of a typical professional situation; and another that focuses on the study of the practical processes involved, on generating alternatives, and on justifying different decisions compared to the original choice made. In both studies the authors propose supporting the learning process by adopting the pedagogical scaffolding technique.

In this sense the work of Owensby and Kolodner (2002) is essential; “since case-based reasoning provides a computational model of the process of not only selecting, analyzing, and applying cases, but also of promoting transfer, we begin with a discussion of the suggestions that case-based reasoning makes for promoting good case application in the context of promoting transfer. We then focus on Learning by Design^{TM2}, which has its foundations in case-based reasoning, problem based learning, constructivist approaches to education, and communities of learning ...”.

Application of this methodology usually follows a common cycle (Lynn, 1999): individual reading and preparation, small-group discussion, a plenary session for discussion and individual reflections. Some variants explained by Romm and Mahler (1991), cited by

² Learning By Design:
<http://web.archive.org/web/20051128121056/http://www.cc.gatech.edu/projects/lbd/htmlpubs/caseapp.html>

Buffington and Harper (2001), include: individual processing centred on isolated student resolution, chronological or simultaneous group discussion where learners discuss in sub-units and then in a plenary session, and chronological or simultaneous group dramatization, similar to the previous strategies, but with an emphasis on role-playing.

3. Case-based Learning as a Driver for Competence Acquisition

CBL is not intended to provide answers; instead, it raises reasonable and logical questions compelling students to engage in a decision-making process that arrives at a logical, coherent and sustainable solution. From a pedagogical perspective the case study should enable the students to meet the course's learning objectives.

Case studies can help the student develop the following generic skills (some of them adapted from Roper & Millar, 1999):

1. identifying and recognizing problems,
2. searching for, understanding and interpreting data,
3. understanding and recognizing assumptions and inferences, as opposed to concrete facts,
4. thinking analytically and critically,
5. understanding and assessing interpersonal relationships,
6. exercising and making judgments,
7. communicating ideas and opinions,
8. sharing and contrasting opinions and assumptions,
9. negotiating with different actors,
10. making, defending and justifying decisions,
11. working with teams (collaboratively),
12. applying social and ethical skills.

Other than these skills, we focus on the development of specific professional and research competences for our Master in e-Learning. The competency map³ of this Masters program is based on competences recognized worldwide as standards in the field- such as the IBSTPI - and which, as previously mentioned, define the instructional designer (Richey, Fields & Foxon, 2001), training manager (Foxon, Richey, Roberts & Spannaus., 2003) and instructor (Klein, Spector, Grabowski & de la Teja, 2004) competency frameworks. This is in accordance with the efforts of the AECT (2000) for Instructional System Design (ISD) management and development process competences and the Eiffel⁴ group for teacher/trainer and e-Learner competences.

4. Research Approach

Although the use of case studies has a long tradition and has been widely adopted in the educational field, it has usually been used in traditional classroom contexts. The vast majority of the references we have mentioned are based on this face-to-face mode of

³ E-learning Master's Degree at UOC: <http://www.uoc.edu/masters/oficiales/general/index.html>

⁴ EIfEL: European Institute for E-Learning. The eLearning Competency Framework for Teachers and Trainers: <http://www.eife-l.org/publications/competencies/ttframework/>

action. Much less has been documented about the use of this method in virtual environments and online teaching and learning.

However, in the last few years, there has been some experience gained in the use of case studies in virtual learning environments, some interesting examples of which are: UNCLE⁵, SMILE⁶, CASEmaker⁷, ICON⁸ and others.

The Open University of Catalonia (UOC) is a virtual university; established in 1994, and currently has over 40.000 students, fully online. At this stage, UOC wants to develop all of its programs through a competence-based curricula design. Learner-centred pedagogy is appropriate to this end, and case method appears to be an optimal solution, despite the long and vast experience and literature that refers predominantly to its application in the face-to-face classroom. Consequently, the main aim of this study is to examine how case-based learning methodology should be applied to virtual environments by identifying key features for the use of this pedagogical strategy in these settings, and what implications it has for case design, development and implementation.

5. Research Methodology

Our chosen research methodology has been qualitative, as we wanted to discover the potential advantages and concerns when developing online interactive case-based learning. Given the fact that literature on research methodology states that qualitative research could be appropriate to elicit tacit knowledge and subjective understandings and interpretations and to delve into little-known phenomena or innovative systems (Marshall & Rossman, 2006), we thought this was the most appropriate methodology for our study.

In addition, qualitative methods allow the researcher to study particular issues in-depth, as cases or events and data collection are not constrained by presupposed categories of analysis. This approach helps to delve further into these qualitative data (Patton, 1987) identifying emergent categories for analysis and interpretation according to the research focus and the relevance of information.

A literature review on case-based learning was the first step in this research in order to understand the current state of affairs regarding the subject. This enabled us to identify key elements describing: main and related concepts, underlying pedagogy, related learning strategies, advantages and disadvantages of its use, generic competences enabled, typologies, guidelines for writing the case study and the teaching notes, teaching and learning methodology and experiences, classroom and online applications and implementations and developments in the learning object trend.

Concurrently, 12 case studies of different educational programs developed in the last six years at UOC were also analyzed in order to identify the design, structure and educational purpose of these cases. The models, guidelines and recommendations that UOC itself has been using during this period were also analyzed. Using this approach, a comprehensive evaluation through the interpretation of experiential knowledge was developed (Stake, 2004)

⁵ UNCLE (Using notes for a case-based learning environment): <http://www.emeraldinsight.com/Insight/ViewContentServlet?Filename=Published/EmeraldFullTextArticle/Articles/0860140104.html>

⁶ SMILE (Solution Mapping Intelligent Learning Environment): http://eric.ed.gov/ERICDocs/data/ericdocs2/content_storage_01/0000000b/80/24/53/df.pdf

⁷ CASEmaker: <http://www.casemaker.com/>

⁸ ICON (Interactive Case-based Online Network): <http://icon.hms.harvard.edu/>

and criteria, desired results, needs and improvements for a new proposal were also identified.

Thus, a series of semi structured interviews were applied to faculty from different disciplines (educational sciences, information technologies, industrial engineering and labour and social sciences) at two universities (UOC and UPC – The Catalanian Polytechnics University) that use the case method in their online, blended or face-to-face teaching. Interviews helped elaborate mechanisms to develop new explanations, meanings and ideas (Patton, 1987). Both the literature review and the analysis of the case studies were used to identify the criteria with which we built the questionnaire and analyzed the interviews. The interviews, focused not only on the implementation of case method, but also on how this method is embedded into the entire course pedagogical strategy. Contextual information was gathered for better interpretation of the data.

Questions were asked about the type of course, program, theoretical and/or practical orientation, number of students, use of technology, type and support of learning materials and applied pedagogical strategies.

Specific information about the case method was acknowledged:

1. *design and implementation*: we explore the teacher's design or redesign of the case study and teaching notes, the process of creation and implementation (including an individual or team work approach), the teacher's experience in design and implementation of the case approach;
2. *type*: no typology was proposed, we wanted a free explanation of how the teacher understood it;
3. *relevance*: the case as the main pedagogical approach, as an "activity" into the course, number of cases employed in the course;
4. *targeted learning objectives and competences development*.

Finally, the analysis was described in a final report which allowed us to establish the criteria that would gauge the decision making about the typology of cases to propose and the type of tools and models to develop.

6. Results

6.1. Dimensions of Analysis

As we mentioned above, a previous analysis of different data collected from more than six years experience in our own university allowed us to identify interesting dimensions to be included in the semi-structured interviews. These were organized into four fundamental dimensions of analysis: 1) the description and typology of the matter, 2) the pedagogical and theoretical approach, 3) the instructional process proposed by the professor through the teaching plan, and finally, 4) the instructional design support received.

6.2. Considerations to Take Into Account After the Analysis of the Interviews

From the professors' interviews, the following items were also highlighted so that they would be taken into consideration when developing the final version of an interactive case study:

- The use of an interactive case-based methodology positively influences student's satisfaction – especially course methodological issues – because it leads to a perception of a more practice-based learning approach.
- This methodology also makes individual learning easier.
- Learning application, critical analysis, situations and settings comparison and decision making are very relevant kinds of objectives that can be achieved through the use of case-based methodology.
- Faculty support in the design and implementation of interactive case studies is critical. Instructional designer tasks, expertise on teaching methodologies and other guidelines should be integrated when defining a model for elaborating this methodology.

6.3. Characteristics of the Prototype

A prototype of interactive case-based learning has been developed considering a number of issues identified as key elements in the literature review: to simulate real-world complexity, to use multimedia in the presentations, to use hyperlink/hypertext navigation features (Kovalchick, Hrabec, Julian, & Kinzie, 1999); to provide students with comprehensive information, expert modelling and challenges to be solved; to promote active learning by simulation models and to ask students to take control and responsibility (Semrau, Fitzgerald & Riedel, 2001); and to gather information, identify issues, create solutions, receive feedback, and gain experience through problem solving (Koh & Branch, 2004).

Taking into account these considerations, we developed a prototype that included these features:

- design process of writing the case study and the teaching notes;
- development process of producing the raw data;
- technology implementation process of integration into a Learning Management System (LMS);
- teaching and learning process implementation.

Independently of case complexity or objectives, we focused on the kind of interaction to propose a generic model that could support any type of case. Our research objective was to build a basic structure that expresses the case teaching-learning scenario together with the possibility of reuse and personalization. In this sense, we aimed to create a high-level case model that can be run in a LMS, that supports any kind of case complexity or objectives and that permits us to introduce some variables for case personalization. We understand personalization as the student's choice of a personal learning itinerary according to their own professional goals (Mor, Minguillón, Santanach & Guardia, 2005):.

Designing learning is a complex process and many models have been outlined to guide and support the task. We have addressed the case approach as an instructional design matter. We found it appropriate to adopt a concept of instructional system design (ISD) defined as “an organized procedure that includes the steps of analyzing, designing, developing, implementing, and evaluating instruction” (Seels & Richey, 1994, p. 31), a pertinent and complete perspective that enables us to understand the case approach as a whole and integrated process, as outlined in the generic design method known as ADDIE (Analyze,

Design, Develop, Implement, Evaluate). An analysis of communication issues related to the role of the instructional designer in the process of designing resources for learning can also be found in Botturi and Del Percio's article (2007) in this volume. We are talking about more than just how to distribute content. It's clear that designers must take into account the kind of learning they would like to foster and for whom the materials are intended, taking into consideration what roles the instructor, the learner, and the contents or resources play in the learning process (Sangrà, Guàrdia & Gonzalez-Sanmamed, 2007).

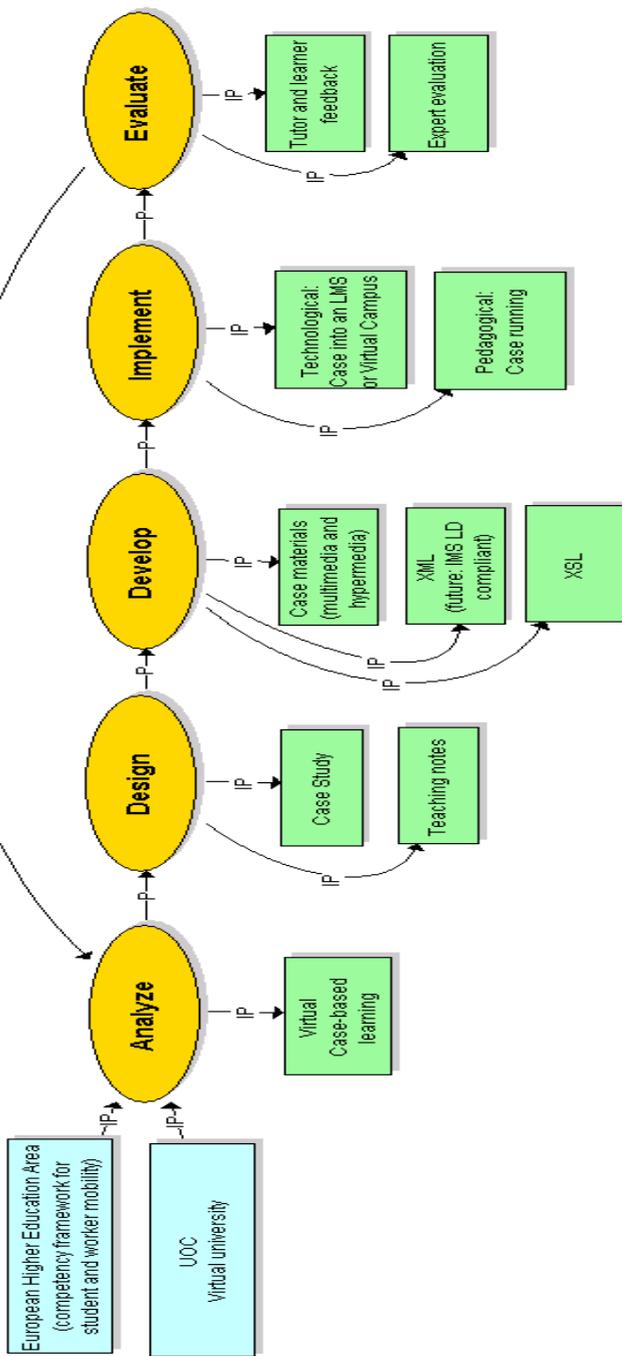
This techno-pedagogical point of view aims to create a coherent process for a better accommodation and integration of design, development and implementation tasks based on a common background of coherent and shared principles for designers, developers and tutors.

From the *Analysis-phase* we have been able to locate the arguments for virtual case-based learning adoption; from the *Design-phase* we have gone past just writing cases to designing of multimedia and hypermedia case studies that support personalization and also including the teaching notes as additional information for case pedagogical implementation (running); from the *Development-phase* we have included the rich media learning material and have added the requirement of developing from a learning object approach for interoperability and reusability together with the standardization of a customizable front end; from the *Implementation-phase* we have differentiated the technical aspects of case integration into a LMS from the teaching-learning context; and finally, from the *Evaluation-phase* we hope in future research to proceed to a complete validation of our holistic case approach.

Our aim is to establish a generic case structure to guide the writing of the case study and the teaching strategy. The teaching notes will include teacher and learner roles descriptions. The common case high level structure will be respected for the technical programming and implementation of the case into the learning management system. An in-house UOC XML language will describe the case main components that, through a style sheet in XLS, will give the front end of the case to both teacher and learner, giving access to multimedia and hypermedia content and communication tools for discussions. We also include an exercise to develop the case study in an Instructional Management System Learning Design (IMS LD)⁹ compliant form.

⁹ IMS LD: <http://www.imsproject.org/learningdesign/index.html>

Fig. 1. “...an organized procedure that includes the steps of analyzing, designing, developing, implementing, and evaluating instruction”(ADDIE Model).



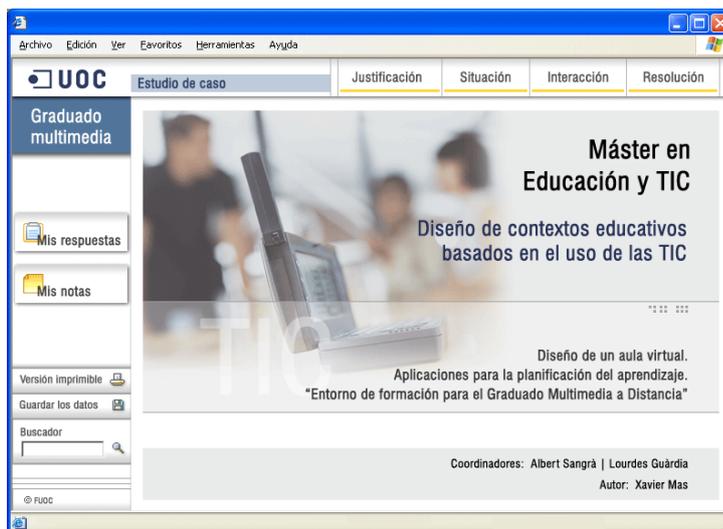


Fig. 2. Snapshot of a prototype for cases to be implemented at the Máster en Educación y TIC (e-learning) at UOC.

6.4. The Four Component Case Model

The case study model is based on four main components: justification, situation, interaction and resolution.

1. The *Justification* focuses on the pedagogical aspects of the case. It presents the learning objectives of the case and corollary competences to be developed through the case exercise. It also includes the main characteristics of the case in terms of the interaction required and the itinerary to follow.
2. The *Situation* introduces the general definition of the case problem and its parameters and limitations. It includes the descriptive elements of the context, the organization, the main and secondary characters or other particularities. This section is informative, mainly for reading or consultation on the part of the student.
3. The *Interaction* component is crucial because it goes deeper into the problem by segmenting it into subunits. The learner, instead of being introduced to the case with all the information, has to participate in some individual and/or collective activities and has to answer some specific questions that will let them gather more information in this way. Thus, the student receives additional information at the same time as they actively takes part in this search, making decisions and taking notes as a way to build a more complete picture of the situation. While the case is going on, the student uses the “electronic notebook” to describe the decisions and documents related with the case. The notes are permanently accessible and can be edited and e-mailed to the virtual classroom, where collaborative tools and forums are used by professors and students. The activities can have an individual or collective character. In this section the student has access to both synchronous and asynchronous communication tools and to a repository of shared documents. This section is more dynamic and at the same time constitutes a space for participation and elaboration of the information.

4. The last component, *Resolution*, is based on the fact that several professional dilemmas will be generated (Mostert & Sudzina, 1996). Through the previous sections the learner was able to gather enough information to seek a solution. This last component shows the individual or collective resolution of the activities that will be evaluated by the teacher and that are suggested from the teaching plan presented at the very beginning of the course. Through reading and reflection, the previous sections will allow the student to have all the available information about the case and the direction it should take. These activities consist in solving other types of problems that the case can give rise to.

6.5. Case-based Learning and LO Approach

As we have stated, our main purpose is to develop tools for the design, development and implementation of case method in virtual environments. As mentioned, UOC is a virtual university working through its own virtual campus that supports administrative, management, teaching and learning tasks for all the actors involved. Thus, a development team together with professors and university staff work on continuous improvement and innovations of the Campus. A number of institutional R&D projects are exploring the Learning Object (LO) approach in order to allow the reusing of learning content. There are some learning technology standards that assure reusability and interoperability of compliant content. The LOM (Learning object meta-data) is an internationally recognized standard that adopts the IEEE¹⁰ (2002) LO definition of "any entity, digital or non-digital, that may be used for learning, education or training". Along the same lines, SCORM (Sharable Content Object Reference Model)¹¹, an Advanced Distributed Learning initiative, presents itself as a collection of standards and specifications that provide a suite of e-learning capabilities in order to enable interoperability, accessibility and reusability of Web-based learning content. These standards define a number of meta-data for content description using the XML (Extensible Markup Language) language, a text based language increasingly used for web data exchange.

Even though UOC courses have an XML structure, the in-house learning materials have yet to conform to any standard that would make them interoperable with other LMS (Learning Management Systems).

Encouraged by the LO development, we also wanted to explore the possibilities offered by this approach to case-based learning. Case method as a pedagogical strategy can be interpreted as a teaching/learning scenario. The content-driven LO paradigm does not present the most suitable solution for our purpose. Studying other initiatives in this field, we have found that the IMS LD specification could better fulfill our requirements of building a generic high-level case method capable of reusability and eventually interoperability.

IMS-LD, for IMS Learning design, is a specification for the description of teaching/learning strategies. This educational modelling language (EML)¹² was developed by researchers at the Open University of the Netherlands and approved by the IMS technical board in 2003.

¹⁰ IEEE-LTSC: ltsc.ieee.org

¹¹ SCORM: <http://www.adlnet.org/index.cfm?fuseaction=scormabt>

¹² EML (Educational Modelling Language): <http://eml.ou.nl/introduction/explanation.htm>

Koper and Oliver (2004) expose seven requirements for the development of a UoL (Units of Learning):

- completeness for fully describing a teaching-learning process,
- pedagogical expressiveness of sound pedagogical approaches,
- personalization based on different criteria,
- compatibility with other specifications and standards,
- reusability of the UoL or parts of it in other contexts,
- formalization through a formal language that is machine readable,
- reproducibility for repeated execution in different settings.

IMS-LD is based in a theatre-play metaphor to describe a pedagogical metamodel capable of expressing new pedagogical approaches. The main element is a Unit of Learning (UoL) that decomposes into a series of Plays, which themselves split into a series of Acts that can be, in turn, divided into activities (learner and staff) and aggregated as activity structures. Different roles are established to perform the activities using resources (as learning objects) and services, the whole composing a learning flow. There are three levels in the Specification, levels A, B and C, where level B adds Properties and Conditions and level C completes the scenario by adding Notifications. These levels are important as they allow collaboration and personalization of the learning process.

Based on our four-component-case-model we made an exercise of modelling it as a Learning Design. We have used the MOT+LD¹³ software tool for graphical IMS LD modelling of level A. This approach lets us build a generic model that can be personalized at the Play level and deploys into four Acts (Justification, Situation, Interaction and Resolution: Fig 3), where the first two are individual and the rest may allow collaboration depending on the case method adopted by the teacher (Fig. 4).

¹³ MOT+LD is a tool developed by LICEF-TELUQ; it is a graphic editor that allows the edition of learning Units

Fig. 3. Generic structure of four Acts

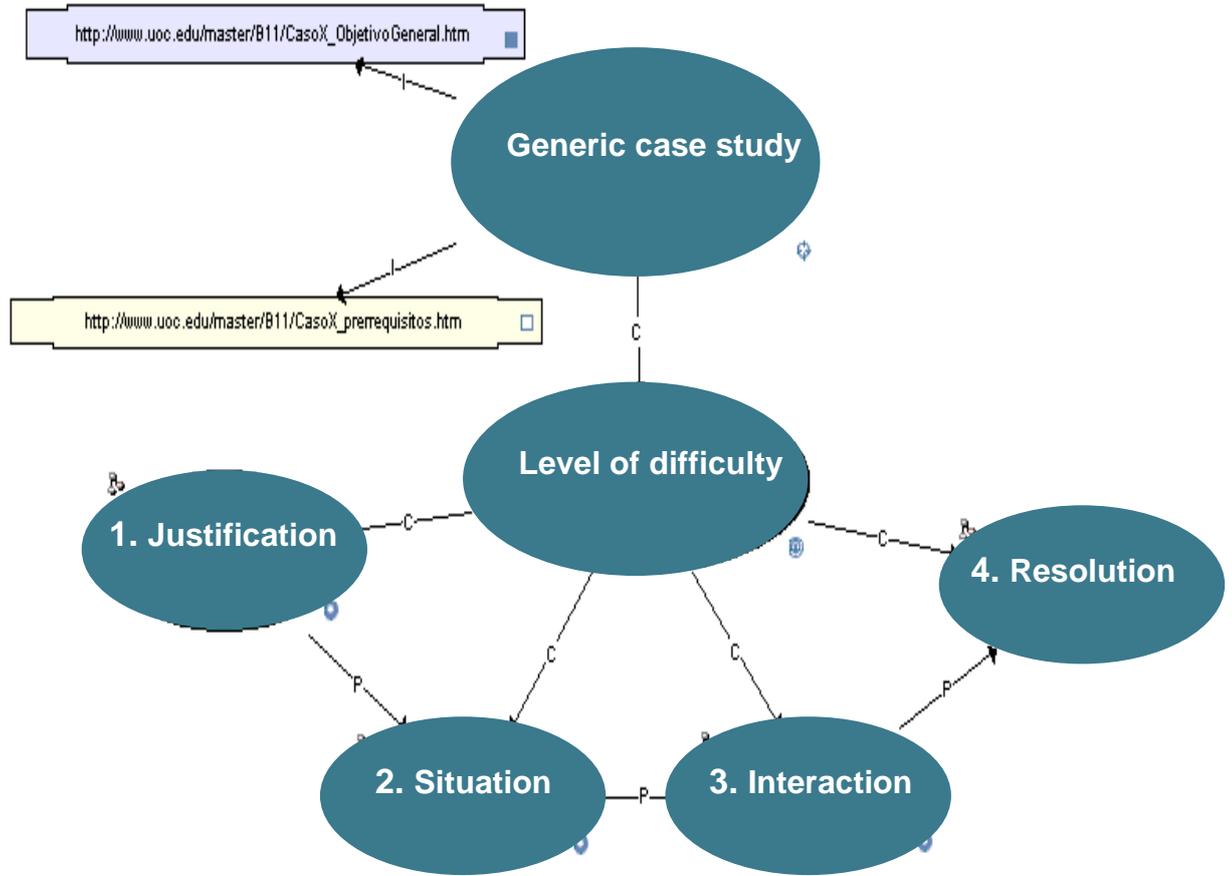
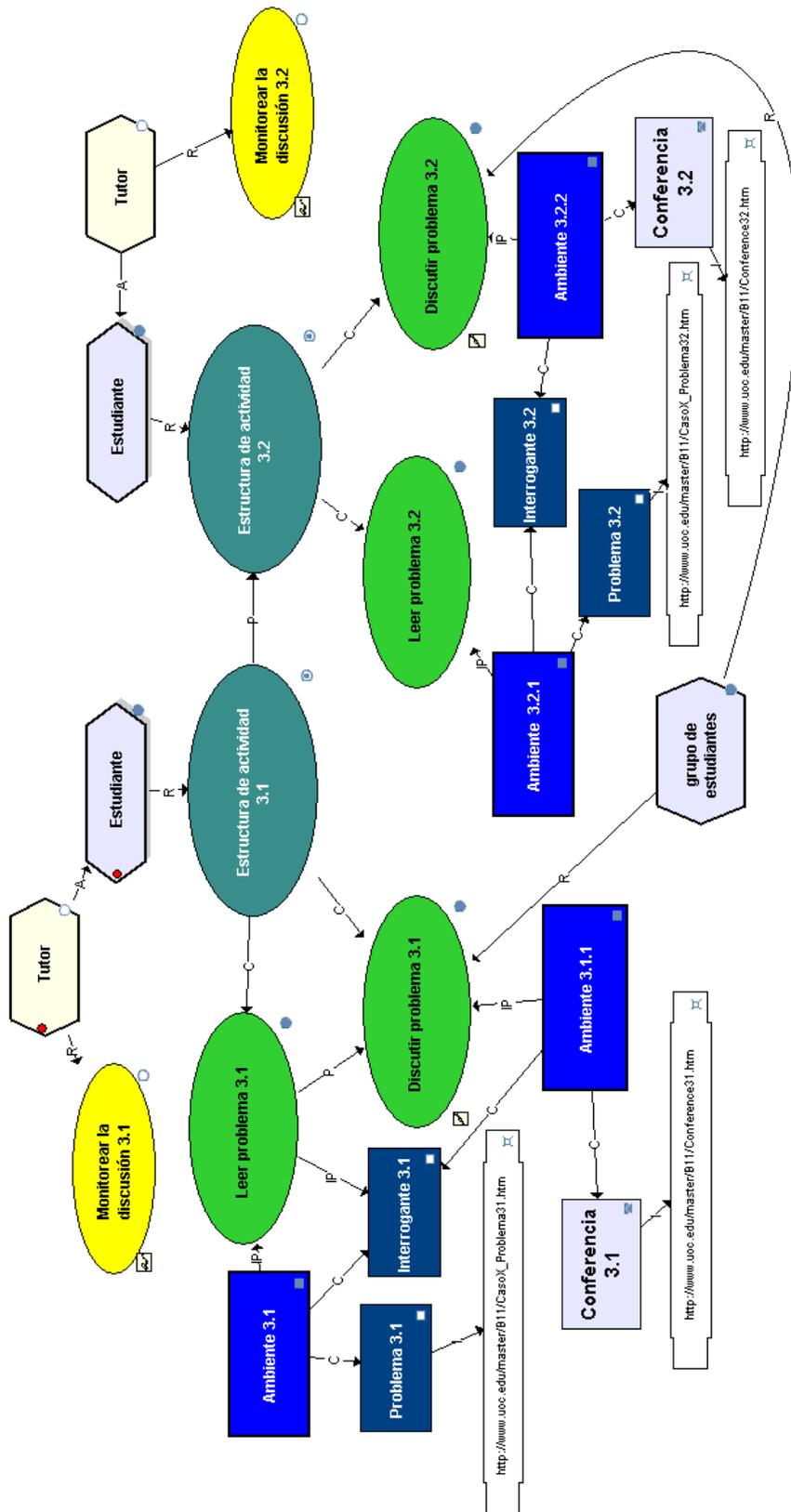


Fig. 4: Example of activity structure of collaborative activity for Act 3, Interaction.



The learning-flow scenario was exported as an XML (compliant with the IMS LD specification) and run in the Reload Learning Design Player¹⁴ to test its appearance and functionality. Even at the test level we found encouraging results as it enabled us envision the capabilities in this approach, both at the implementation and designing stages. Even at the level of speculation, we can foresee a better integration of design/development/implementation processes with this kind of tool. Some further development and refinement is needed to provide assistance and guidance to teachers/designer to help them create and develop the case method from this new perspective.

7. Conclusions and Further Research Possibilities

Interactive case-based learning is an appropriate educational strategy that responds to two main current institutional requirements: the development of competence-based curricula harmonized with the European Higher Education Area and the adoption of a socio-constructivist teaching and learning approach adapted to virtual environments.

The case approach in virtual environments facilitates hyperlinked multimedia information consulting, synchronous and asynchronous debate and knowledge sharing, personalized and continuous teaching support, individualized learning itineraries, high realistic simulations and collaborative learning.

Faculty using this learning methodology believe that there is a need for having tools to facilitate interactive case-based studies design and implementation. Also guidelines and training in how to take advantage of the possibilities arising from this methodology are very much needed.

The adoption of an interactive case-based learning holistic approach accelerates the case design, development and implementation process, ensuring quality throughout the process reducing the distance between design and programming, enabling communicability between multiple actors and facilitating personalization, reusability and interoperability of cases. In this sense, IMS-Learning Design specification is capable of successful CBL pedagogical implementation.

This holistic approach to learning design requires the creation of a series of handbooks to assure coherence and adherence to the principles guiding different processes executed by different actors. Thus, the development of a handbook for competence-based learning design through case studies for teachers is needed. Provision of a technical handbook for the creation of learning specification, compliant case structures and front end style sheets is also needed.

A first prototype of a case study that put into practice the design and development phases of our model has been developed and tested. To proceed to the evaluation of the technical and pedagogical implementation of our test case study should be the next step in this research.

The second part of this research will be to ask students to test the prototype to find out which benefits they perceive when using it as a learning strategy, and also to ask faculty if they believe it responds to their needs in terms of a teaching strategy.

¹⁴ The Reload Learning Design Editor (LDE) is an Open Source, close-to-specification, tree-based Learning Design (LD) editor written in Java using the Eclipse platform.

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