International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-2, Issue-8 E-ISSN: 2347-2693

Design and implementation of a Socioconstructivist Model of Collaborative Learning Design (SMC-LD) dedicated to distance learning

Abderrahim EL MHOUTI[1*], Azeddine NASSEH[2] and Mohamed ERRADI[3]

[1*,2,3,] *Laboratoire de l'Informatique, Recherche Opérationnelle et Statistique Appliquée (LIROSA), Abdelmalek Essaâdi University, Morocco*

www.ijcaonline.org

Received: 16/07/ 2014 Revised: 28/07/ 2014 Accepted: 24 /08/ 2014 Published: 31 /08/ 2014

***Abstract*—** Today, the use of web technologies in education allows envisaging new learning forms, giving a preponderant place to the social dimension. However, with the emergence of these new orientations, are also developed difficulties in implementing pedagogical contents adapted to this new type of learning (collaborative, cooperative, etc.). This work is at the heart of this issue. It seeks to find conceptual and computer solutions, both at the pedagogical and technical levels, for computer modeling of pedagogical knowledge, which should be in adequacy with current learning practices. It gives itself as main objective to develop a reference model for production of distance learning contents adapted to the socioconstructivist learning context. Thus, this work proposes to develop a Socioconstructivist Model of Collaborative Learning Design (SMC-LD) of distance learning contents. In this model, the process of content development is based on socioconstructivist approach and focuses on two main aspects of production of learning content: "design" and "development". At the level "design", SMC-LD suggests a collaborative design process based on the concept of life cycle. At the level "development", SMC-LD proposes a process for educational modeling, upstream of SCORM and IMS-LD standards, describing pedagogical content using scenarios and activities. The modeling process is facilitated by an author tool to produce interoperable and reusable learning objects. To implement the proposed approach, XML and Java technologies were used.

***Keywords*—** Socioconstructivism; learning design; collaborative design; development; learning object; distance learning; norm and standard.

I. INTRODUCTION

Today, the pedagogical possibilities made possible by digital technologies constituting a main lever for the modernization of practices of distance learning. With the emergence of this new orientation of teaching are also developed difficulties of implement pedagogical contents that adapt at best to this new type of learning (collaborative, socioconstructivist, etc.). In this context, the important international movement to establish norms and pedagogical standards for online training has changed the way that we exercise the practices of learning design [1].

However, the mediatization of pedagogical contents for online learning raises many questions. Various studies show that, from a pedagogical point of view, these contents do not perform their function [2] [3] and that they are individually designed [4] [5]. Other studies show that many standards of pedagogical modeling give little of place to pedagogical aspects or show a complexity of use because they have a strong interest in standardization and issues of reuse [6] [7] [8].

The work presented in this article fits in the light of these findings. It relates of the work on learning design and is focuses mainly on the processes of design and development of pedagogical contents of distance learning by means of Learning Objects (LO). This work has as main objective to search conceptual and computer solutions, both at the theoretical, pedagogical and technical levels, for computer modeling of pedagogical knowledge, which should be in adequacy with current learning practices (socioconstructivist, collaborative, etc.).

It comes to implement an online system of collaborative design and development of pedagogical contents, based on the socioconstructivist approach, and taking into account the whole process of learning design. LO produced are indexed using a LOM (Learning Object Metadata) application profile adapted to our needs. These LO are designed collaboratively and mediatized through an authoring tool which proposes an educational modeling process upstream of SCORM (Sharable Content Object Reference Model) and IMS-LD (Instructional Management Systems-Learning Design), and addressing himself to non-expert end-users.

The paper is organized as follows: after having reviewed the main characteristics of the socioconstructivist approach, on which is based the proposed model, and the main characteristics of norms and standards of educational modeling, this article describes generally the proposed model and explains the theoretical and methodological foundations on which it relies by describing the design process and the process of developing pedagogical contents. The article goes on to describe the conceptual structure, the software architecture well as technical choices adopted to implement

Corresponding Author: *Abderrahim EL MHOUTI*

the model. Finally, the article describes some interfaces of the implemented prototype and concludes with future works.

II. RESEARCH BACKGROUND

The changes performed by digital technologies are particularly determinant when it comes to the subject of the educational act: the pedagogical content. However, the implementation of content suited to the current learning context can not succeed without the taking into account of some pedagogical and technical aspects. This work focuses on two main aspects.

The first aspect relates to the design phase of the learning design process. Although most of what we see as individual learning becomes collaborative, and spite of the diversity of actors involved, the design of distance learning contents is effected in most of the time individually [4] [5]. Indeed, if the design of such contents correctly assumes the principles of learning design, it does not take into account the collaborative side, which generates pedagogical contents unsuited to the socioconstructivist vision, vision increasingly advocated in the world of distance learning.

The second aspect concerns the mechanisms for implementing pedagogical contents using Learning Objects. In this context, the relevance of several norms and standards of educational modeling had been the subject of continuous debates and controversies [9]. These standards continue to privilege the document lists approaches, focused on the aggregation and diffusion of content (case of LOM and SCORM) or demonstrate a complexity of use for non-specialists, and therefore concern expert educational engineers (case of IMS-LD). On the other hand, authoring tools implementing these models use creation environments proprietary, which can lead to the problem of portability of content produced, and of interoperability between these tools [10].
This work fits in this issue of design and implementation of pedagogical contents used in distance learning. This problematic makes complete sense when large volumes of distance learning contents exist, and therefore the question of their pedagogical quality becomes critical [2].

III. SOCIOCONSTRUCTIVISM

The concern to properly educate learners has pushed the pedagogues to use the findings of psychology in their field. In this framework, like the behaviorism, cognitivism and constructivism, the socioconstructivism is one of the most recent learning theories.

Developed by Lev Vygotski (1896-1934), and based on the constructivism of Jean Piaget (1896-1980), socioconstructivism is defined as an approach to learning according to which knowledge acquisition is facilitated by the inclusion of social field of learner [11]. The social world of a learner is a central concept in socioconstructivism. It includes people who directly affect the learner: teachers, colleagues, etc.
In a complex situation where the learner tries to resolve a problem, socioconstructivism then introduces an additional dimension in the construction of knowledge and the development of skills: the multiple social interactions, exchanges, collaboration, etc (Fig. 1).

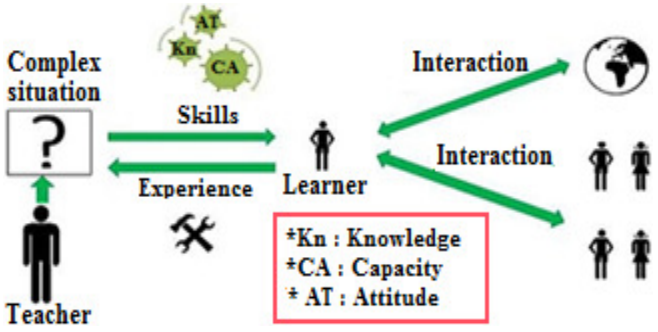

Fig. 1. Learning according to the socioconstructivist model

Socioconstructivism is an approach increasingly favored in the world of education [12]. This approach demonstrates superior efficacy compared to more traditional approaches (behaviorist model, transmissive model) and the set of current research work on education are in the same perspective. Let us also note that if socioconstructivism seems to be advocated at the present time, it is far from being opposed to other educational models but it allows bringing together the common points between these models.

Today, and in the context of rapid technological evolution, distance learning constitutes a privileged field of application of socioconstructivist approach [13]. Digital spaces on Internet offer many tools for sharing and exchange allowing to develop all the fundamental concepts on which is based this approach: Zone of Proximal Development (ZPD), socio-cognitive conflict, metacognition and shoring process [14].

IV. NORMS AND STANDARDS OF EDUCATIONAL MODELING

With the large amount of heterogeneous digital resources on the Web, modeling pedagogical contents can not be done currently without taking into account the norms and the standards. These standards aim to ensure the accessibility, interoperability and reusability of LO produced.
Pedagogical norms and standards can be classified according to different levels of operations [15]. In the following are presented four of the main existing norms and standards.

A. LOM

LOM is an internationally recognized open standard published in 2002 by the LTSC (Learning Technology Standardization Committee) of the IEEE (Institute of Electrical and Electronics Engineers). The objective of this standard is the description of LO. The LTSC that developed the standard defined LO as being “any entity, digital or non-

digital, that may be used for learning, education or training". The LOM data model specifies which aspects of a LO should be described and what vocabularies may be used for these descriptions; it also defines how this data model can be amended by additions or constraints.

The LOM comprises a hierarchy of elements containing nine categories at the first level: General, Life Cycle, Metadata, Technical, Educational, Rights, Relation, Annotation and Classification. Each of which contains sub-elements; these sub-elements may be simple elements that hold data, or may themselves be aggregate elements, which contain further sub-elements. The semantics of an element are determined by its context: they are affected by the parent or container element in the hierarchy and by other elements in the same container.

B. SCORM

The SCORM is a collection and harmonization of specifications and standards that defines the interrelationship of content objects, data models and protocols such that objects are sharable across systems that conform to the same model. This specification of the Advanced Distributed Learning (ADL) promotes reusability and interoperability of learning content across Learning Management Systems (LMS) [16].

The SCORM has releases dating back to 2000 with SCORM 1.0. SCORM 1.2, released in 2001 is the final version of SCORM before the integration of sequencing. Beginning in 2004, SCORM began to version with different editions of SCORM 2004. The most recent release (2009) is SCORM 2004 4th Ed.

SCORM is composed of three sub-specifications:

- The *Content Packaging* section specifies how content should be packaged and described. It is based primarily on XML (eXtensible Markup Language).
- The *Run-Time section* specifies how content should be launched and how it communicates with the LMS. It is based primarily on ECMAScript (JavaScript) API (Application Programming Interface) that is provided by the LMS.
- The *Sequencing section* specifies how the learner can navigate between parts of the course. It is defined by a set of rules and attributes written in XML.

C. EML (Educational Modeling Language)

EML was developed by Rob Koper at the Open University in the Netherlands. Koper propose a point of view that differs from its predecessors by affirming that within a learning environment, these are further the activities that are central than objects of knowledge [17].

EML attempts to describe the learning process itself, rather than the content and materials conveyed. It describes roles, resources and activities, and maps the different interactions that can occur. On a practical level, EML attempts to define the different strategies which a learner might utilize to achieve a specific competency, supporting the concept that different pedagogic models facilitate different learning styles. In practice, this means that the learner may choose any one of a number of paths through their learning material, depending on which one suits their individual learning style best. Such a strategy could be particularly well supported through e-learning, and represents a considerable advantage over face to face learning where a single delivery mode may be the only economically viable course delivery mode.

D. IMS-LD

The work about the EMLs, introduced with EML-OUNL, is actually standardized in the IMS-LD specification [18]. This standard allows to specify formally Learning Unit (LU) corresponding to the description of the resources and the scenario managing them (contents/scenario separation thanks to a method that specifies the roles, the activities of each role and the resources manipulated during the execution of these activities). The IMS-LD specification concerns pedagogical engineers who are expert of this language [19]. Although IMS-LD was finalized, some initiatives already propose prototypes of authoring-tools compatible with IMS-LD: Edubox, Reload, etc. However, no authoring-environment addresses the multidisciplinary team in charge of the design of the LU: the non-expert end-users. The elaboration of models with languages like IMS-LD concerns the latest of the design phase; it is required that a scenario was already pre-established by teachers. Models examples based on the UML language, and more particularly the activity diagrams, illustrate well how the results of analysis, the stories, could be graphically described as virtual learning scenarios on which formal models using the IMS-LD language will be specified. So, the IMS-LD specification encourages the use of activity diagrams from UML for these upstream steps of the design process [20].

V. PROPOSITION

This section presents an overview of the Socioconstructivist Model of Collaborative Learning Design (SMC-LD) contribution. Firstly, the section provides a global overview of the proposition: the SMC-LD is presented and discussed about its modeling capabilities for collaborative learning design. Secondly, this section presents the theoretical and methodological basis of SMC-LD and sketches the conceptual model captured within both the Content Elaboration System (CESys) and the Management and Integration System (MISys). Finally, the section presents the SMC-LD implementation realized thanks to software tools.

A. Global overview

Considering the findings raised in the research background section, and starting from the fact that, for any creative process, the most important work resides at the design [21], this contribution intervenes at the level of the design phase of the instructional design process of distance learning. It supports the design phase for the steps of initial requirement, analysis, design and detailed design (Fig. 2).

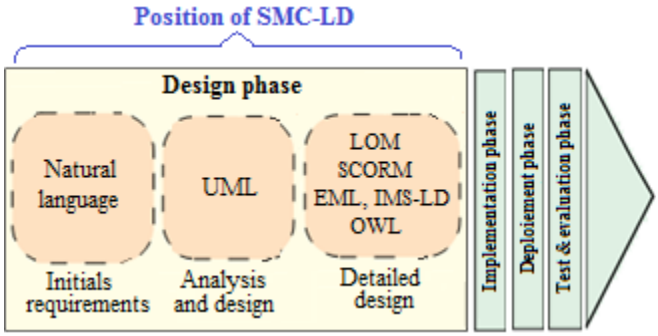

Fig. 2. Position of the contribution within the instructional design process

SMC-LD is a model dedicated to the design and elaboration of LO. It is a method of collaborative design and modeling of learning units, upstream of SCORM and IMS-LD models, and is focused on strategies based on the socioconstructivist approach. This proposal comprises two complementary parts (Fig. 3).

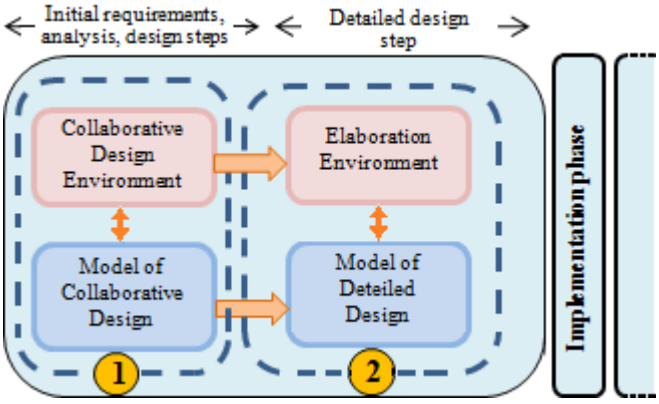

Fig. 3. The two parts constituting the SMC-LD

In the SMC-LD, the two parts cover respectively the two mains aspects which the model is interested: "Design» and «Development". The following text describes each of the two parts of SMC-LD.

B. *First part of SMC-LD*

To accompany the sliding of learning practices from the individual toward the collaborative, and therefore produce pedagogical contents adapted to this new learning context, this work proposes as a first contribution to establish a model of collaborative design (and not individual design) of pedagogical contents used in distance learning. The objective is to take into account the socioconstructivist approach in the design process, since this approach considers that the content to be learned always wears the color of the context in which it is designed.

This model covers the first three steps of the design phase of the learning design process (Fig. 3). The design is assured according to a well-defined approach, based on a generic life cycle adapted to the design of content according to an incremental process broken down into tasks to be completed collaboratively.

The design, which takes place in an online *Collaborative Design Environment*, is becoming less the fruit of an isolated author, but it is team work consisting of a pedagogical coordinator and several authors in charge of the design of pedagogical contents. The authors, freed from the constraints of time and place, should collaborate and exchange relevant data. The pedagogical content does not stay frozen in time, it evolves and can be revised by a succession of authors. Likewise, the content, that becomes unified, is segmented into elements finer granularity in order to distribute the design work between different authors.

C. *Second part of SMC-LD*

The second proposal is based on the finding that at the level of detailed design step (Fig. 2), the relevance of several norms and standards of educational modeling been the subject of continuous debates and controversies [9]. This step (detailed design) of the learning design process is the subject of the second proposal.

Thus, we were inspired of works on these educational standards for provide a method of modeling of LO upstream of SCORM and IMS-LD models. The method is situated between SCORM model, centered on the aggregation of content, and IMS-LD specification that takes into account the notion of process (scenarios, activities, roles, etc.) but which manifests a complexity of use for non-expert users.

This second part of SMC-LD proposes therefore to extend and restructure the SCORM model by incorporating aspects derived primarily from work on EML and IMS-LD: add activities and take into account the social dimension by adding a new role which is the “group”.

All the pedagogical functions described above are implemented in the form of an author tool that allows facilitating the generation of LO compatible to SCORM format, and thus allows ensuring the reusability and interoperability of these LO. This tool, which represents the *Elaboration Environment*, is designed as a module integrable to the online *Collaborative Design Environment* or to any LMS.

This second contribution is a complement to the first. It constitutes the second part of the SMC-LD and covers the detailed design step of the design phase of the learning design process (Fig. 3).

VI. THEORETICAL AND METHODOLOGICAL FOUNDATIONS OF SMC-LD

A. *Collaborative design process of content*

The collaborative design process of contents is similar to what we find in the domain of software engineering. The design is ensured according to a life cycle adapted for this purpose. The choice of using a life cycle brings several advantages [22]: promotes traceability, improves the visibility on the evolution of content, promotes the constitution of teams of collaborative work, etc.

Considering its advantages, the choice fell on the model known as "V-Cycle". Fig. 4 illustrates the steps of the

collaborative design process of contents. It should be noted here that the detailed design step been the subject of the development process (Section *B*).

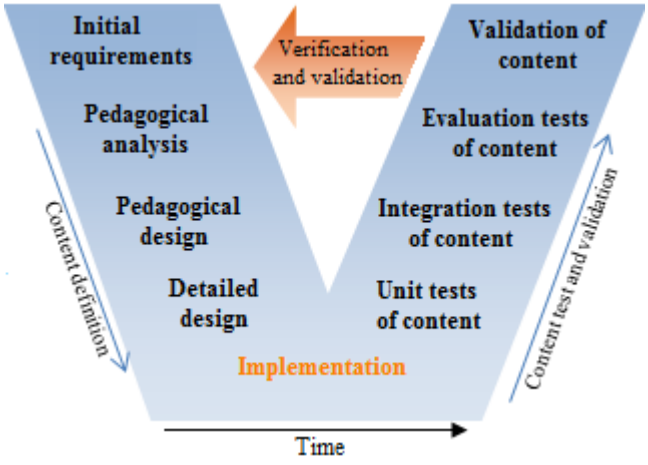

Fig. 4. Life cycle of collaborative design process

The design process takes place in an online "Collaborative Design Environment" and is done in natural language and through descriptive texts and schemas. On completion of this process, the authors must have a database of detailed resources in order to deduce the graph of the sequence of activities of learning unit and their staging by role.

B. Development process of LO

In SMC-LD, the structure of a Learning Unit (LU) is constructed from three components:

- Objectives and prerequisites: they fix the utilization framework in terms of the knowledge or skills;
- Components: they allow to describe the entities required to implement the learning unit;
- Method: she describes the unfolding of the learning unit and how different actors will be brought to use different resources.

To take into account socioconstructivist approach, this structure introduces, in addition of the usual roles: "learner" and "teacher", a new role which is the “group” (Fig. 5).

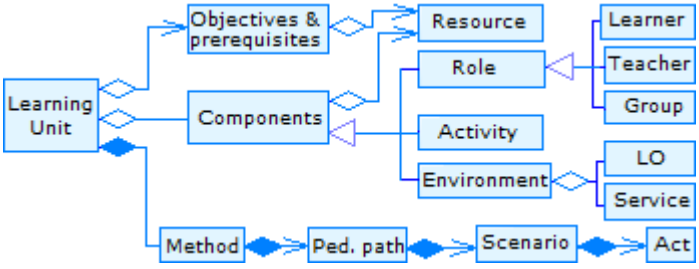

Fig. 5. General structure of a learning unit

The process of developing an LO therefore consists in describe the structure of the LU in terms of objectives and prerequisites, components (roles, activities, environment, etc..) and method necessary for the implementation of this unit. This process is composed of three main steps: structuring of content, creation of learning path and creation of didactic scenario. These steps will be described in detail in the following.

1) Structuring of content

This step consists in structuring the LO. The comparative study of main pedagogical norms and standards allows us to say that the structure the more apt to represent a LO, taking into account the criteria for indexing and reuse, is the hierarchical structuring.

The LO is structured as a tree whose root is the LU and the branches are composed of concepts: sub-LU, activity, sequence and act. Each level of the tree possesses properties (Fig. 6).

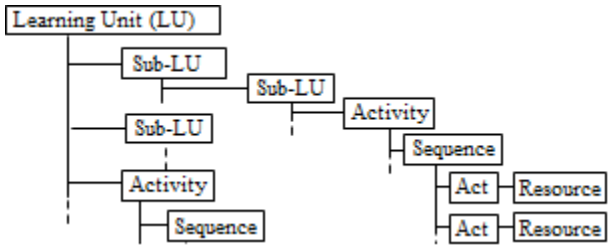

Fig. 6. Hierarchical structure of a learning unit

This type of structuring aims to distinguish between pedagogical, didactic and mediatic resources. It also aims to rendering the proposed model independent of any pedagogical approach. This allows the consideration of the socioconstructivism as basic approach.

2) Creation of learning path

This step consists in creating learning paths in order to organize and describe the transitions between activities. This allows the learner to move from one activity to another according to his profile (defined by two parameters: target population and level), its objectives and the available sequences.

A new dimension will therefore be added to the proposed hierarchical structure, thus determining the direction of learning paths. The tree structure will therefore transformed, after the definition of learning paths, at an activity graph that combines the hierarchical and network organization (Fig. 7).

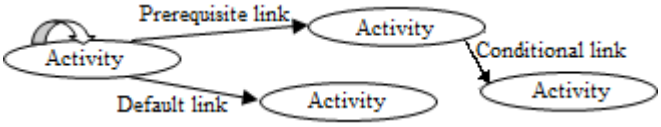

Fig. 7. Graph of activities of a learning object

In this new type of structuring, transitions between activities can be expressed through four types of links: default link, prerequisite link, conditional link and empty link.

3) Creation of didactic scenario

This step consists of creating didactic scenarios in order to plan sequences relating to an activity. The scenario organizes the knowledge of the activity in a series of pedagogical acts,

sequentially executed on mediatic resources used (text, image, video, etc).

The proposed development process determines a new scenario for each learner or group in order to diffuse him a course adapted to his profile. These scenarios are established according to specific rules, which allow performing dynamic transitions from one act to another (Fig. 8).

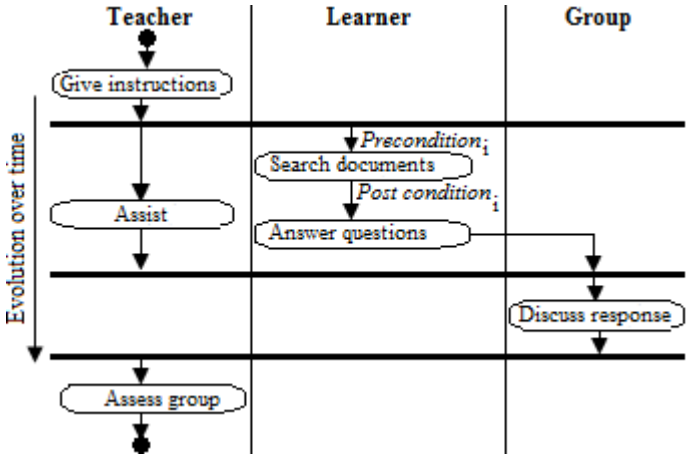

Fig. 8. Representation of a didactic scenario into acts

A sequence has an initial state of start and a final state to meet. Transitions made between two acts are performed in accordance with the rules of precondition and post-condition. Pre-conditions and post-conditions are values associated to acts (e.g. the time spent on the act).

C. *Technical choices*

1) Indexation of LO

To index the LO produced, an LOM application profile was used. The choice of this standard is justified by its implementation in most storage systems of LO [23] and its capacity to facilitate the sharing and reuse of LO. The LOM application profile chosen allows to overcome the criticisms worn on this standard (abstraction, genericity, etc.), and responds to our LO classification that aims to distinguish between pedagogical resource, didactic resource and mediatic resource.

2) Collaborative Design Environment

The Collaborative Design Environment of contents is implemented using an LMS adapted to our needs. We chose to use an LMS because the work realized in this article is a work of learning design, and not a work aimed the establishment of a new platform.

3) Elaboration Environment

This environment should be designed as an authoring tool responding to pedagogical functions described above. It should also be portable, convivial and adapted to novice teachers in computer science. To meet all these constraints, it was chosen to use the Java programming language to develop this environment and the XML standard for the storage format of LO produced.

Thus, the LU produced includes resources, web links, activities, roles, acts, sequences, etc, assembled in a Zip file (Fig. 9). This zip file can be easily stored, shared or imported into SCORM-compatible software, usually a LMS.

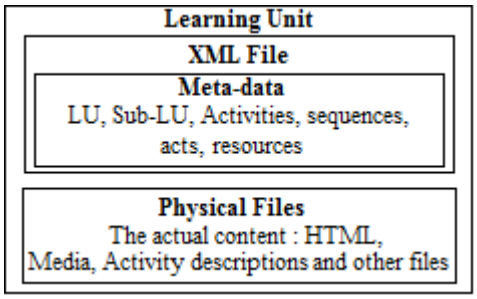

Fig. 9. Technical architecture of a learning unit

All of the tags related to the structure and the type of their content will be defined using the Document Type Definition (DTD) or XML Schema. The rules of adaptability or display will be defined in the XSL stylesheets (eXtensible Stylesheet Language).

It is noted that different technical choices cited above will be presented and justified in the implementation section.

D. *Synthesis*

In the SMC-LD, the modeling of a learning unit follows a process consisting of two complementary phases (Fig. 10):

- *Collaborative design phase*: it is taking place in three steps: initial requirements, analysis and design. It is done collaboratively and in natural language according to the V life cycle, and through an online "*Collaborative Design Environment*".
- *Development phase (detailed design)*: it is taking place in three steps: structuring of content, creation of learning path and creation of didactic scenario. In this phase, the content development is done through an "*Elaboration Environment*", developed in the form of an authoring tool.

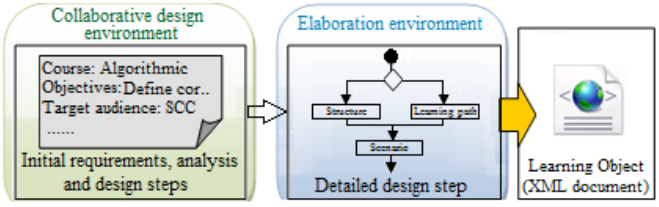

Fig. 10. Process of design/development of a LO using SMC-LD

The result of the modeling process, which includes the two phases described above (collaborative design and development), is an interoperable and reusable LO, formalized by an XML document structured in accordance to the proposed model.

VII. CONCEPTUAL ARCHITECTURE OF SMC-LD

The general architecture of SMC-LD is based on the main functionalities ensured by the model: collaborative design and development of distance learning contents (Fig. 11).

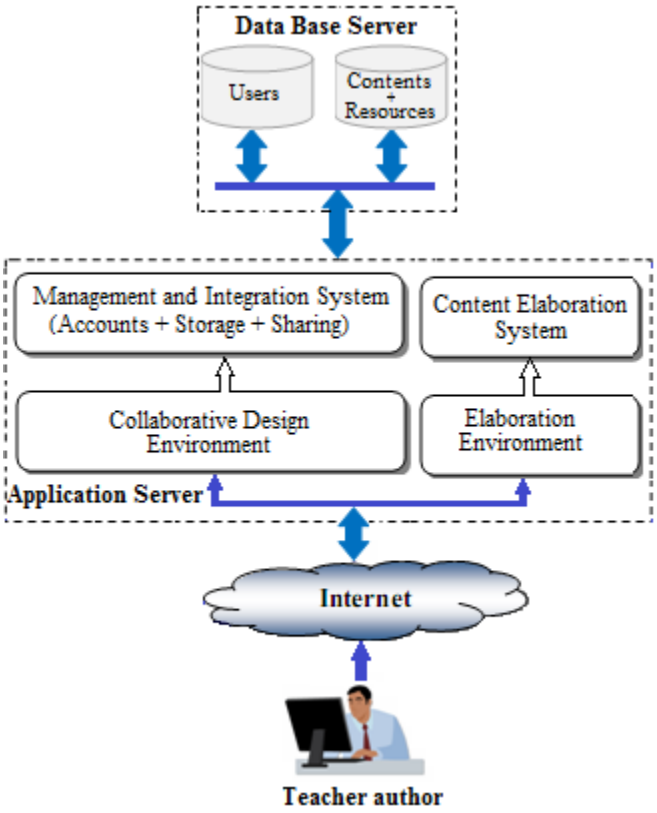

Fig. 11. General architecture of SMC-LD

In this architecture, we can distinguish two constituent parts of SMC-LD: "*Management and Integration System*", which ensures collaborative design of contents, and "*Content Elaboration System*" which ensures contents development. In what follows, are described each of the two systems.

A. *Content Elaboration System (CESys)*

CESys is a teacher environment allowing to modeling, creating or editing LO according to the development process defined above (section *VI-B*). This system offers to authors four types of tasks:

- Pedagogical task: creating the structure and the learning path;
- Didactic task: didactic planning;
- Mediatic task: mediatization of scenarios and designing the interface of the LO;
- Technical task: indexing, storage and import of resources.

These functionalities are implemented as modules (Fig. 12).

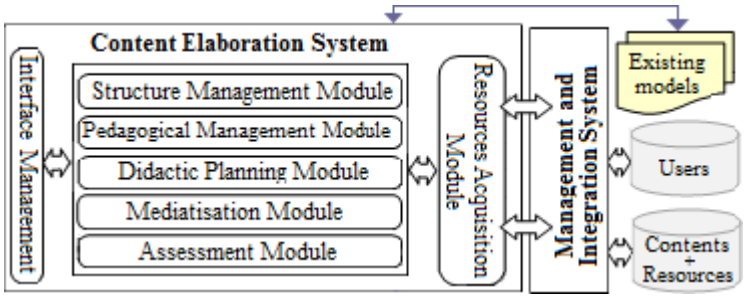

Fig. 12. General architecture of CESys

At the end of the development process, the CESys generates the executable version of the LO produced. This version can be imported and tested in MISys to simulate a learning situation.

B. *Management and Integration System (MISys)*

MISys aims to make available to teachers an online environment allowing multiple possibilities. This is an LMS that ensures two main functions:

- *Management function*: MISys serves to manage the database of LO, resources, users accounts, training, etc. It also offers the possibility to test the developed content and simulate its use.
- *Integration function*: MISys brings together the functionalities of SMC-LD by:
  - *integrating the Collaborative Design Environment* of contents. The collaboration is facilitated by the exchange and sharing by using communication tools (chat, forum, video conferencing, etc.);
  - *integrating the CESys* as an additional module, which enables online creation of LO.

MISys is used by three types of actors: administrator, teacher and learner. The identification allows the user to access the interface that is dedicated to him. In the case of the teacher, it will eventually pass to CESys.

MISys has a modular architecture. It includes CESys as contents development module as well as other modules of managing users and resources, of indexing, of tracking, etc. (Fig. 13).

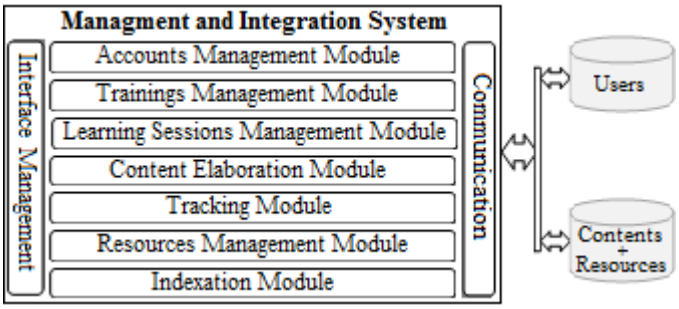

Fig. 13. General architecture of MISys

To ensure the expected functionalities, MISys communicates with the database of resources and actors as well as with the interface of CESys.

VIII. IMPLEMENTATION

To implement the two systems (CESys and MISys) that compose the SMC-LD, the software architecture adopted is based on evolved technological choices, used in the development of modern forms of distance learning (Web 2.0 technologies). In this architecture, the CESys is developed with the Java programming language. The system interface is presented in the form of a Java applet, which it loads and runs through a Web browser. On the other hand, an LMS playing the role of MISys was used.

The implemented prototype includes a "teacher environment" offering the possibility of collaborative design and development of contents, and a "learner environment" giving the opportunity to attend training paths (Fig. 14).

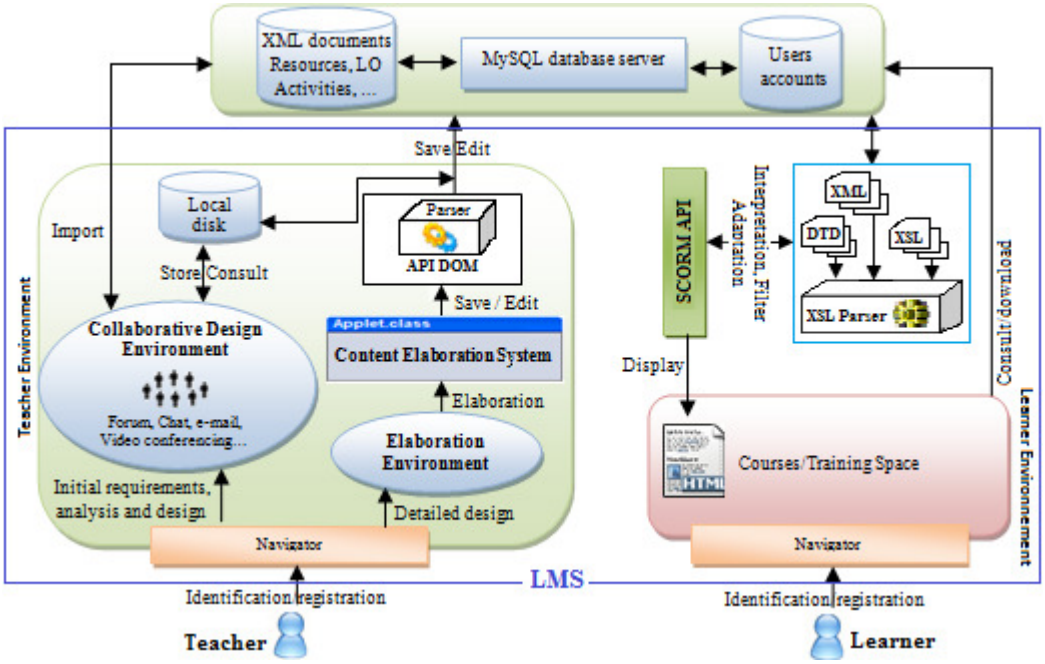

Fig. 14. Software architecture of the prototype implemented

This architecture, open and scalable, allows to customize and to develop the system in order to extend its basic functionalities. Many modules and extensions that allow enhancing the prototype can be downloaded and integrated freely. In what follows, the different software tools adopted in this architecture will be presented and justified.

A. *Management and Integration System*

As mentioned earlier, MISys is implemented using an LMS. The wide choice of open source solutions has led us to use an LMS adapted to our needs: ensuring management of authors and LO compatible to SCORM format, integration of CESys and collaborative work tools (forums, videoconferencing, chat, Mind mapping, etc.). Thus, following the comparative study of the main existing LMS, and view ease of use and pedagogical flexibility it brings, the choice fell on the Dokeos LMS.

MISys is therefore set up using Dokeos (version 2.1). This LMS works under Linux, Windows and Mac, according to the combination Apache (HTTP server), MySQL (database server) and PHP (development language). It incorporates a tool of Mind mapping, called Dokeos MIND, very useful in collaboration between authors. Dokeos can also manage LO compatible to SCORM format. Fig. 15 shows the main interface of MISys.

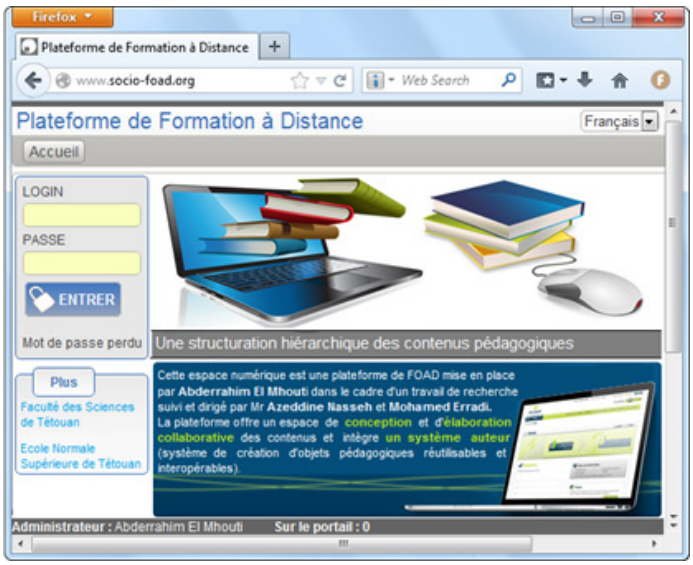

Fig. 15. Main interface of Management and Integration System

B. *Content Elaboration System*

Given the functionalities that the CESys must offer, the choice of programming language is directed to Java. It is an object oriented language, portable and having a great richness of basic libraries. These qualities seem appreciable to develop the CESys in the form of a Java applet that can be integrated into MISys or any LMS.

To describe the structure of LO and their indexing, it was agreed to use XML. Indeed, XML is adapted for the storage and manipulation of documents representing the LO, and this through the granularity and the markup syntax very suitable for the hierarchical structuring adopted to organize pedagogical content. On the other hand, XML separates content from the presentation by using XSL. Finally, XML allows to standardize description of LO produced and ensure interoperability and reusability.

The passage XML-Java is done using the Java DOM (Document Object Model) API. Java DOM is a standard proposed by the World Wide Web Consortium (W3C) and plays the role of interface to edit an XML document. This parser is perfectly suited to the programming of interactive applications, in which the entire graphical trees of an XML document is exposed to the application, and, through it, to the end user.

Finally, in order to render available and to test the SMC-LD, the prototype implemented has been hosted on a Web server that runs under Linux. It should be noted that this prototype can run without modification under other operating systems supporting a web server, PHP and MySQL as relational database management system. Fig. 16 shows one of the interfaces of CESys allowing adding a sequence.

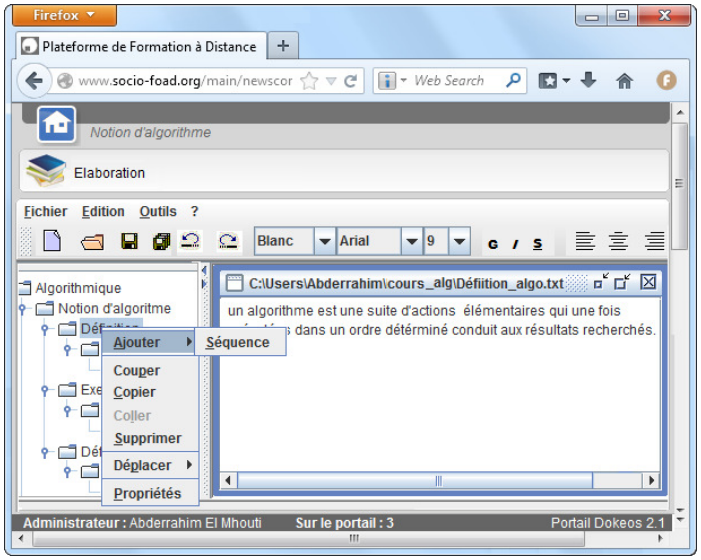

Fig. 16. Content Elaboration System

The creation of teaching materials is therefore facilitated by this author interface (Fig. 16). It is a dedicated editor, based on the pedagogical functionalities defined above, and allows the generation of standardized learning objects.

IX. CONCLUSIONS AND PERSPECTIVES

In this article, we have presented our work about a generic model adapted to collaborative design and development of distance learning contents. The introduction of such a model seeks to assist and guide teachers in implementing pedagogical contents best suited to the current distance learning context.

Indeed, the transition of Learning Design practices, to accompany the current learning context (socioconstructivist, collaborative, etc.), can not succeed without the consideration of some pedagogical and technical aspects. This work is focused on two main aspects.
The first aspect concerns the design step of the learning design process. In this context, SMC-LD proposes to establish a collaborative design process of distance learning contents. The consideration of the collaborative side leads to the production of learning content suited to the socioconstructivist vision, which is increasingly advocated in the world of distance learning.

The second aspect concerns the content development step of the learning design process. This step is confronted to the problem of the relevance of norms and standards of educational modeling. In this context, SMC-LD proposes a method for modeling LO upstream of SCORM and IMS-LD standards. The production is done using an authoring tool that describes the different components of a pedagogical scenario and facilitates the generation of the standardized LO for non-expert teachers.

In SMC-LD, the proposed approach is based on a structured, logical and stepwise process. It is centered on a collaborative approach which implies taking into account the point of view of teachers from the start of designing of an LO. Due to the fact that software testing is an important activity in the software development process [24], SMC-LD has been implemented by means of a representative prototype in order to test its operationality. The implementation of the prototype is based on a software architecture open source and scalable.

Finally, as a perspective of this work, we plan to experiment practically the proposed model in order to highlight the strengths of our approach to consolidate and its weak points to correct.

REFERENCES

[1] D.A. Wiley, "Connecting learning objects to Instructional design theory: a definition, a methaphor, and taxonomy". In Wiley (Ed), The Instructional Use of Learning Objects. Agency for Instructional Technology and Association for Educational Communications of Technology, Bloomington, Indiana, **2002.**

[2] A. El Mhouti, A. Nasseh and M. Erradi, "An Evaluation Model of Digital Educational Resources", International Journal of Emerging Technologies in Learning, Volume-**8**, No-**2**, Page **29–35**, May **2013**
[3] A. El Mhouti, A. Nasseh and M. Erradi, "Development of a Tool for Quality Assessment of Digital Learning Resources", International Journal of Computer Applications, Vol-**64**, No-**14**, Page **27–31**, Feb **2013**.
[4] F. Trillaud, "Architecture pour le contrôle des interactions et le pilotage d'une application interactive multi-utilisateurs à exécution adaptative : application à un environnement de FOAD", Doctoral dissertation, University of La Rochelle, France, **2013**.
[5] L. Cormier, "Le soutien au développement de ressources numériques pour l'enseignement et l'apprentissage dans les universités québécoises", 80ème Congrès de l'ACFAS, **2012**.
[6] A. Battou, "Approche granulaire des objets pédagogiques en vue de l'adaptabilité dans le cadre des Environnements Informatiques pour l'Apprentissage Humain", Doctoral dissertation, Ibn Zohr University, Morocco, **2012**.
[7] N. Zniber and C. Cauvet, "Modèle orienté service pour la conception de parcours pédagogiques personnalisés", Doctoral dissertation, Aix-Marseille University, France, **2009**.
[8] L. Oubahssi, "Conception de plates-formes logicielles pour la formation à distance, présentant des propriétés d'adaptabilité à différentes catégories d'usagers et d'interopérabilité avec d'autres environnements logiciels", Doctoral dissertation, René Descartes University, France, **2005**.
[9] M. E. Bouabid, "De la conception à l'exploitation des travaux pratiques en ligne : Application d'une approche générique à l'enseignement de l'informatique", Doctoral dissertation, Paul Sabatier University, **2012**.
[10] R. Boughacha and H. Aliane, "Système de productions de contenus pédagogiques multilingues", International Conference on Artificial Intelligence and Information Technology (ICA2IT '14), Ouargla, Algeria, **2014**.
[11] L. S. Vygotski, "Pensée et langage", Traduction de Françoise Sève, Ed Sociales, **1985**.
[12] P. Jonnaert, "Compétences et socioconstructivisme : de nouvelles références pour les programmes d'études", Conférence annuelle des Inspecteurs de l'Enseignement Secondaire, Burkina Faso, **2001**.
[13] N. Chebaane, M. Khemaja, R. Braham and J. Vauthier, "Informatisation de la pédagogie dans l'enseignement à distance", Symposium International en Enseignement à Distance (EAD), Tunisia, **2006**.
[14] A. El Mhouti, A. Nasseh and M. Erradi, "A Socio-constructivist Model of Development of Learning Content in an e-learning Platform Oriented to Management of Academic Knowledge", E-Learn World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education, Las Vegas, United States, Page No **74-80**, Oct **21**, **2013**.
[15] SCTIC (Sous-comité sur les technologies de l'information et de la communication), "Les normes et standards de la formation en ligne, états des lieux et enjeux ", **2002**. Retrieved from: http://www.crepuq.qc.ca/IMG/pdf/norm-0210-d-rapport.pdf
[16] ADLNet, "Advanced Distributed Learning, Documentation Suite (SCORM 2004 4th Edition.)", **2014**. Retrieved from: http://www.adlnet.gov/scorm/scorm-2004-4th/
[17] R. Koper, "Educational modeling language: adding instructional design to exiting specifications", Technical report, Educational Expertise Technology Center, Open University of Netherlands, **2002**.
[18] R. Koper, "Modeling units of study from a pedagogical perspective. The pedagogical meta-model behind EML". Open University of the Netherlands, **2002**.
[19] P. Laforcade, "Towards a UML-based Educational Modeling Language", in the Proceeding of Fifth IEEE International Conference on Advanced Learning Technologies (ICALT'05), ISBN 0-7695-2338-2 Kaohsiung, Taiwan, July **05-08**, **2005**.
[20] IMS, "IMS Learning Design Best Practice and Implementation", Technical report, **2003**.
[21] N. Bousbia and A. Balla, "Processus de modélisation de contenus pédagogiques destinés à la FOAD", Revue électronique des technologies de l'information (e-TI), No **3**, **2007**.
[22] O. Catteau and P. Vidal, "Le Cycle de Vie de l'Objet Pédagogique et de ses Métadonnées", Doctoral dissertation, Paul Sabatier University, France, **2008**.
[23] X. Ochoa, J. Klerkx, B. Vandeputte and E. Duval, "On the Use of Learning Object Metadata: The GLOBE (Global Learning Objects Brokered Exchange) Experience", Lirias KU Leuven, **2011**.
[24] S. Kannan and T. Pushparaj, "A Study on Variations of Bottlenecks in Software Testing", *International Journal of Computer Sciences and Engineering*, Volume-**2**, Issue-**5**, Page No **8-14**, May **2014**.

AUTHORS PROFILE

Abderrahim EL MHOUTI – PhD student in LIROSA laboratory at Abdelmalek Essaadi University, Faculty of Science, Tetouan, Morocco. His research fields are: e-learning, pedagogy and Web 2.0 technologies.

Azeddine NASSEH – Professor and computer science researcher. He is member of LIROSA laboratory. Currently, he is full Professor and head of Management and Computer Science Department at Ecole Normale Supérieure, Abdelmalek Essaadi University, Tetouan, Morocco .

Mohamed ERRADI – Professor and e-learning & Pedagogy researcher. He is member of LIROSA laboratory. Currently, he is full Professor and Trainer at Ecole Normale Supérieure, Abdelmalek Essaadi University, Tetouan, Morocco.