

An Architectural Model for Designing Multicultural Learning Objects

Jaime Muñoz-Arteaga
 Univ. Autónoma de Aguascalientes
 Av. Universidad 940
 Aguascalientes, México
jmauaa@gmail.com

Jean Vanderdonckt,
 Juan Manuel González Calleros
 UCL, Belgian Lab. of HCI
 Louvain-la-Neuve, Belgium
jean.vanderdonckt@uclouvain.be,
juan.m.gonzalez@uclouvain.be

Michael Orey
 University of Georgia,
 Athens, GA, USA
mikeorey@uga.edu

Abstract—Learning objects are considered as educational resources that can be employed in technology support learning. They are a digital pieces of knowledge to put together in order to form courses on line. Considering cultural aspects is possible to reuse them in different context for a large diversity of community of users. Nevertheless, the design and development of graphical user interface for this kind of objects become more complex since the multiples representations and the large diversity of resources. This work proposes the use of architectural models to try to mitigate the design of user interfaces for multicultural learning objects.

Keywords-multicultural context; learning object; Presentation-Abstraction-Control; architectural pattern; usability

I. INTRODUCTION

Nowadays a large number of universities are producing their courses in terms of learning objects and saving these objects in their own repositories, these repositories in general support several local queries with different criteria thanks to the information in the metadata of every object. Such repositories have the goal of opening access to a wide variety of materials to anyone around the globe [6].

Today, educational content can be easily distributed worldwide via the internet. While this is easy to do, it is apparent that in all of these materials there is both intentional educational content and unintentional cultural content. Some talk about bias in learning materials, but this tends to be pejorative. We prefer to say that culture is in whatever you create. Whenever you create educative content, you put a bit of yourself into the content. This part is often a representation of your own culture and even if you deliver that content in your classroom where you are intimately familiar with your students, there are parts of that content that are difficult for all of your students to understand that have nothing to do with the educational content.

Learning objects are considered as educational resources that can be employed in technology support learning. They are digital pieces of knowledge to put together in order to be part of courses on line. A traditional learning object is composed of five components such as: objective, theoretical knowledge, evaluation, practical knowledge and a metadata [3][6]. A traditional learning object can be enrichment through the clearly identification

of cultural factors such traditions, best practices and customs (see Figure 1). These cultural aspects are taken into account since they could help to learn in a more familiar manner to the members of a society. Then, a Multicultural Learning Object (MLO) could be used for different cultures and the learners could better understand in his/her own educational terms.

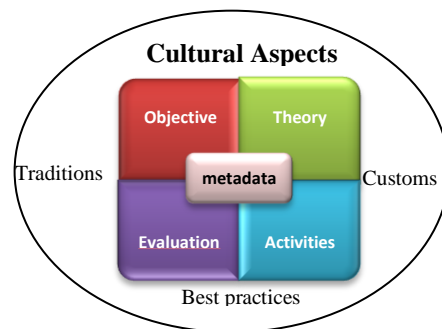


Figure 1. Components of a multicultural learning object.

Monocultural perspectives hamper learning in a number of ways. Students are not exposed to or do not engage with different forms of knowledge or realities. Students are not encouraged to learn about or engage with a diverse group of people. As a consequence, there is no conception of alternative ways of thinking and acting, hindering imagination and criticism, with the potential to promote arrogance, insensitivity, providing a fertile ground for prejudice. Multiculturalism puts forward the existence of multiple (multi) cultures as opposed to one (mono) particular culture within an educational system and society at large. As a countermovement to the established educational system, it attacks a constructed reality that is often referred to as ethnocentrism or monoculturalism. This is essentially to change the conceptualization of culture, moving from unitary to pluralistic perspectives [2] [7].

In the e-learning literature, there are several theories that support multicultural education, but only a few contributions propose to build multicultural learning object to deal with the complexity of instructional design for MLO [2] [12]. This work proposes an architectural model to design and develop multicultural learning objects in an effective manner. For this goal, section two gives an outline of problem; next section presents our proposal in terms of a conceptual model in order give some solutions. Section

four shows the design of a course with multicultural learning object as a case study in order to prove the current proposal. Finally, section five describes a series of related works.

II. OUTLINE OF THE PROBLEM

A multicultural learning object always pursue the idea of reusable interactive components, it is necessary a good quality of graphical user interfaces for different contexts, so a MLO could be delivered for an initial population but also to as many groups with another culture. In this sense the production of MLO's become complex, it is necessary several amounts of educative resources and a big multidisciplinary team with different competences. However, this responsibility is left to the analytical and creative decisions of developers even if this task is not easy to carry out.

This work identifies the following difficulties for the production of multicultural learning objects:

- A major evolution of instructional design for a massive production of multicultural learning objects is necessary.
- It lacks of specification techniques enable to support interactive digital educative content taken into account multicultural context.
- It is necessary identify some new criteria to evaluate the quality of multicultural learning objects.
- It lacks a methodology to develop MLO's where the requirements of different stakeholders are taken into account.
- Multicultural learning objects require a high interactivity, reusability and usability. In particular the treatment of visual feedback requires of several abstraction levels.

Next sections describe some solutions to the aforementioned problems.

III. ARCHITECTURAL MODEL

The design and development of multicultural learning objects requires in particular a big effort in the specification of the graphical user interface in order to support a large diversity of users. According to Shneiderman [1], the user interface is the specification of the look and feel of an interactive application. The production of a multicultural learning object is similar of an interactive application where the user requirements and cultural context are important in particular in the development of graphical user interface. The design of a graphical user interface includes the determination of which interactive components are displayed to the user and the functions that let to interact with these components in order to support user task.

We can assume that the creation of educative material in the form of multicultural learning objects might be strongly influenced by culture, such as, what people value, how they learn, solve problems, put in practice and so forth. Then, all multicultural learning object need to be

translated, localized, and adapted in profound ways to suit the needs and preferences of learners in other cultures. Localization addresses obvious visual and textual differences found in other cultures, such as widgets, icons, menu items, symbols, and so forth [15]. Amiel and Orey [7] presented an illustrative example for develop a simple multicultural learning object from an applied mathematics curriculum, that demonstrates that demonstrates the process of computing the area of a home in the United States for the purpose of estimating how much carpet should be purchased. In particular the GUI of this object requires to be modified in order to be used in Brazil to estimate how many boxes of ceramic tile would be needed. While the computational algorithms are the same, the measurement units used in the two countries are different (square yards versus square meters) and the actual floor coverings are also different since in Brazil, carpet is not common, while tile is. Another example is the use of addition operation which could be used in exercises, simulation and evaluation sections of a multicultural learning object. The GUI could be modified in function of cultural context, in Italy we could talk about adding pizzas, hamburgers could be used in the United States, and the typical tacos could be used in Mexico.

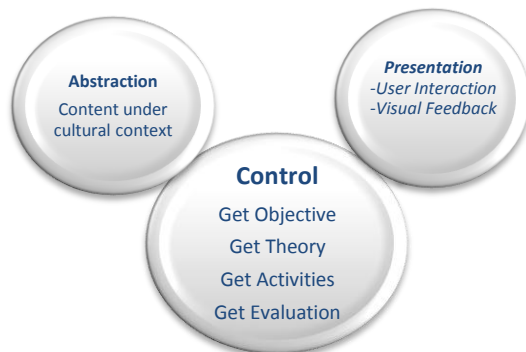


Figure 2. Multicultural learning object model based on the PAC model.

In order to specify the interactive nature of a multicultural learning object, we propose to use the architectural model PAC (Presentation-Abstraction-Control) proposed by Coutaz [14]. The different modules of this architectural model could contain the components of a MLO (see Figure 2): the concept to learn, theoretical knowledge, objective, activities and evaluation, all are specified under cultural aspects. The separation of concerns of cultural context, content and graphical user interfaces could be described by the PAC model. The Abstraction could encapsulate the academic content of a MLO, the Presentation module displays the content with cultures, traditions and customs. This is presented in functions of user interactions and requests send to the Control module. Actually, the presentation module specifies the look and feel of the graphical user interface of a multicultural learning object. Then, the graphical user interface could be separated from the academic content (Abstraction) given different representations in functions of user requirements.

It is well known that users could learn of different manner and, in general, different learning styles should be proposed [16]. In addition, we consider here that cultural aspects (traditions, best practices and customs) could help to learn in a more familiar manner, all the members of a society. A PAC agent could represent a particular perspective. The different perspectives require their own resources and their own graphical user interface. In additions, the reusability and maintainability could be feasible using PAC agents without affecting the other properties such as portability and access.

Nowadays, it is possible that several mentors create educative content in different part of a country or world. Internet allows us to find, create easily different good quality of educative contents and deliver them to a large number of societies. A learning object could be created in different locations and in different languages need to be rebuilt or localized in order to satisfy the requirements of each location. Every new MLO specified under PAC model could be integrated simply in a hierarchical structure of PAC agents, each consisting of a triad of presentation, abstraction and control parts. This helps to structure a course where the agents (or triads) can communicate with each other only through the control part of each triad.

IV. CASE STUDY

Mexico is recognized as a country with a rich culture and a large diversity of traditions; one of the reach traditions is the celebration of day of the dead. This case study shows the specification of a multicultural learning object of day of the dead in Mexico. For this purpose, we

present the case study in two sub sections; the first one describes the architectural model at design level and the second sub-section at implementation level.

A. Design level

The celebration of day of the dead are echoed in cities and villages throughout Mexico. As each locality offers distinctive traditions and a unique flavor bound to fascinate the curious traveler, a visit to any Mexican cemetery would be a worthwhile addition to the itinerary of anyone touring the country this time of year [5].

A design of a multicultural learning of the day of the dead requires put clear that this tradition is marked throughout all Mexico by a plethora of intriguing customs that vary widely according to the ethnic roots of each region. Common to all, however, are colorful adornments and lively reunions at family burial plots, the preparation of special foods, offerings laid out for the departed on commemorative altars and religious rites. In general, at elementary school, Mexican students are required to study about their tradition; they could select the multicultural learning object. Consequently, there are a set of MLO's which represents different versions of celebrations of day of the dead in Mexico. This set of MLO's complies with the online course structured by a hierarchy of PAC agents, where the users could select and learn the different manners to celebrate this tradition coming from different regions of Mexico, as follow:

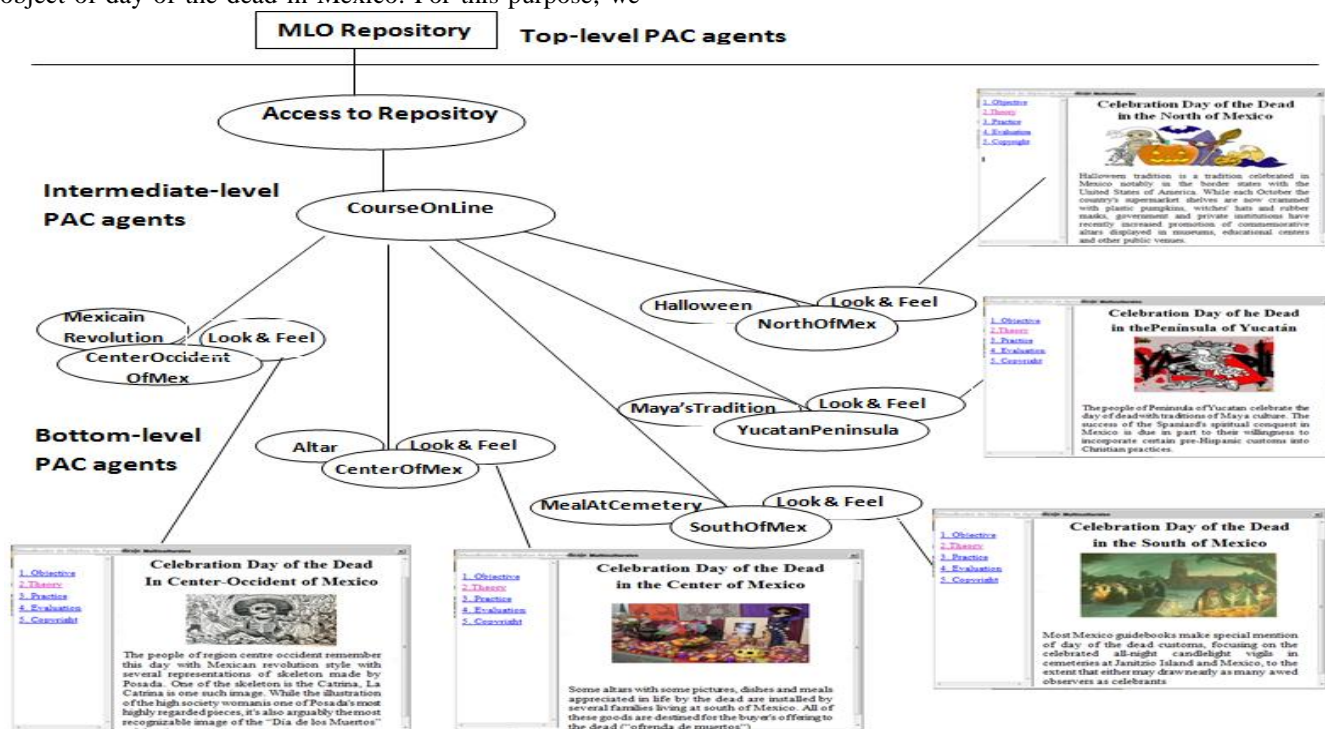


Figure 3. Multicultural learning objects related to the celebration of day of the dead in México.

North of México region.- Halloween is a tradition usually celebrated in Mexico in particular in the border states with the United States of America. Some typical Halloween activities include customs and attending costume parties, ghost tours, and watching horror films, bonfires, visiting haunted attractions telling ghost stories or other frightening tales.

Center of México region.- Most México guidebooks make special mention of day of the dead traditions celebrated in the center of Mexico, in particular in the Janitzio Island, families celebrate the day of dead with dishes, music and night candlelight vigils in the cemeteries.

South of México region.- Some altars with some pictures, dishes and meals appreciated in life by the dead, These altars in honor to dead of familie with several dishes and flowers are installed in the houses at south of Mexico.

Center-Occident of México region.- The people of region centre occident remember this day with Mexican revolution style with several representations of skeleton. One of the skeleton is the Catrina representig a woman who was member the high society. Also the mexican revolution skeletons are considered to wear by the people during the day of dead in Center-Occident of Mexico.

Yucatán península region.- The people of Peninsula of Yucatan celebrate the day of dead with traditions of Maya culture incorporating certain pre-Hispanic customs into Christian practices.

The Presentation-Abstraction-Control pattern [13][14] is an architecture that separates the concerns of an application into a hierarchy of cooperating components, each of which are comprised of a Presentation, Abstraction, and Control. The PAC pattern seeks to decompose an application into a hierarchy of abstractions, and to achieve a consistent framework for constructing user interfaces at any level of abstraction within the application.

Figure 3 shows the hierarchical structure of PAC agents where the top and intermediate-level-agents describe respectively the learning object repository and the main window of course on line. Note that every bottom-level agent describes a specific perspective of celebration of the day of the dead in Mexico. For example, this celebration of the people from Yucatan Peninsula is based on the Maya's customs.

B. Implementation level

Concerning to the implementation of multicultural learning objects under the PAC model specified in previous section, it is possible to describe it using the UML notation, as follow:

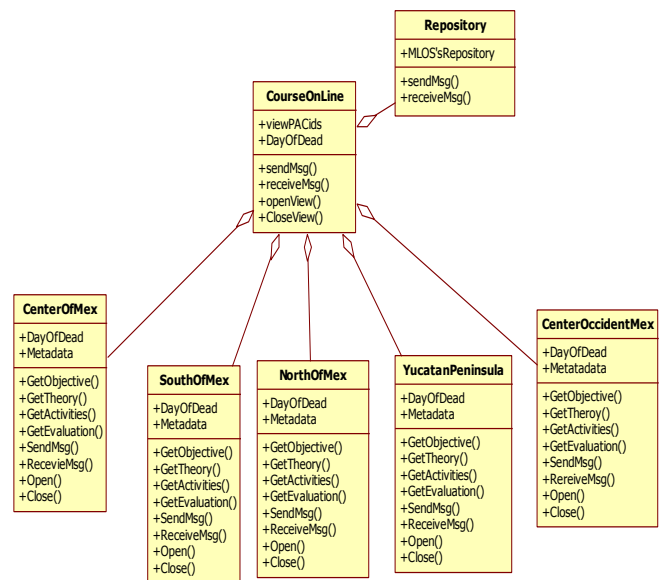


Figure 4. Class diagram of MLO's related to the celebration day of the dead in México

According the UML diagram of Figure 4, the maintenance of the course on line about the celebration of day of the dead is feasible, since the designer of the different regions of Mexico they could update in an independent manner the content of their MLO's. In addition, they could be saved in the repository of this same course on line.

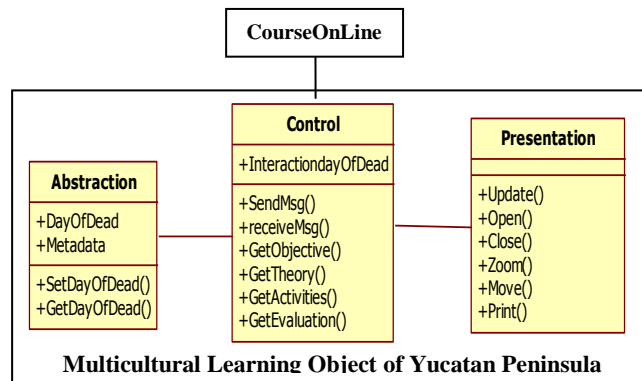


Figure 5. Elements of a multicultural learning object of Yucatan Peninsula according to a PAC agent.

Analyzing the components of a MLO of Yucatan Peninsula (see Figure 5), it is important to identify that a model has their own resources, where the information and metadata of day of the dead are saved as attributes of class Abstraction. This information is accessible by the functions of class Control, such as: *GetTheory()*, *GetActivities()*, *GetObjective()*, *GetEvaluation()*. The results could be displayed in the different interactive components of the graphical user interfaces encapsulated in the Presentation class.

V. RELATED WORK

In the literature of e-learning and human computer interaction, some works have proposed for analysis and development of MLO: Agada has considered the multicultural education as an emerging paradigm [8], Oshlyansky et al. have précised the difference between cultural aspect from usability aspect for the graphical user interfaces at analysis stage [10], Gómez et al. have presented a development of mathematic courses in terms of MLO's [12].

PAC architectural model differs from MVC (Model-View-Controller) [4], in that within each triad, it completely separate the presentation (view in MVC) and the abstraction (model in MVC), this provides the option to assign capsule of information to learn which can give the user experience to learn important perspectives and concepts throughout the graphical user interface of a multicultural learning object.

VI. CONCLUSIONS AND FUTURE WORKS

The design of multicultural learning objects for giving solution to software problems is considered as a complex task which is usually left as a programming activity. This work purposed an architectural model to design and develop multicultural learning objects in an effective manner. We propose an architectural model based on the design pattern "PAC (Presentation-Abstraction-Control). [13], the set of PAC agents represent the diversity of perspectives, traditions and costumes that could help in a more familiar manner to final user, all this information is accessed and shown throughout the graphical user interface of a multicultural learning object.

Finally, it is important to say, that the adaptability, the evaluation and the massive production of multicultural learning objects are research topics to be considered like future work.

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